IN THE UNITED STATES DISTRICT COURT
FOR THE DISTRICT OF MASSACHUSETTS

AMAZIN' RAISINS INTERNATIONAL, INC., Plaintiff, v. OCEAN SPRAY CRANBERRIES, INC., Defendant.	Civil Action No. 1:04-cv-12679-MLW

DECLARATION OF WILLIAM R. WOODFORD IN SUPPORT OF OCEAN SPRAY'S MOTION FOR SUMMARY JUDGMENT OF NONINFRINGEMENT

I, William R. Woodford, declare as follows:

1. I am an attorney in the law firm of Fish & Richardson P.C., P.A. and I am counsel for Defendant Ocean Spray Cranberries, Inc.

2. Attached hereto as **Exhibit 1** is a true and correct copy of United States Patent No. 5,188,861 issued to Mazin et al. on February 23, 1993.

3. Attached hereto as **Exhibit 2** is a true and correct copy of United States Patent No. 1,717,489 issued to Barlow on June 18, 1929.

4. Attached hereto as **Exhibit 3** is a true and correct copy of an Office Action from the United States Patent & Trademark Office dated October 31, 1990.

5. Attached hereto as **Exhibit 4** is a true and correct copy of a Response to Office Action dated April 30, 1991.

6. Attached hereto as **Exhibit 5** is a true and correct copy of United States Patent No. 4,542,033 issued to Agarwala on September 17, 1985.

7. Attached hereto as **Exhibit 6** is a true and correct copy of United States Patent No. 5,320,861 issued to Mantius et al. on June 14, 1994.

8. Attached hereto as **Exhibit 7** is a true and correct copy of excerpts from the 1990 edition of the Code of Federal Regulations.

9. Attached hereto as **Exhibit 8** is a true and correct copy of excerpts from Webster's Third New International Dictionary of the English Language Unabridged, copyright 1993.

I declare under penalty of perjury under the laws of the United States of America that the foregoing is true and correct.

Dated: December 21, 2005

/s/William R. Woodford
William R. Woodford

60329657.doc

EXHIBIT 1

US005188861A

United States Patent [19]

Mazin et al.

[11] Patent Number: 5,188,861

[45] Date of Patent: Feb. 23, 1993

[54] **PROCESS FOR PREPARING A DRIED FRUIT PRODUCT**

[75] Inventors: **Jack G. Mazin**, Maple; **Amir Lalji**, Weston, both of Canada

[73] Assignee: **Royal Domaine Inc.**, Concord, Canada

[21] Appl. No.: **530,863**

[22] Filed: **May 31, 1990**

[51] **Int. Cl.**[5] **A23L 1/212**
[52] **U.S. Cl.** **426/640**; 426/639
[58] **Field of Search** 426/640, 639

[56] **References Cited**

U.S. PATENT DOCUMENTS

1,609,720	12/1926	Humphrey	426/640
1,717,489	6/1929	Barlow	426/640
4,542,033	9/1985	Agarwala	426/640 X

FOREIGN PATENT DOCUMENTS

61-216641	9/1986	Japan	426/640

OTHER PUBLICATIONS

Furia, CRC Handbook of Food Additives, vol. I, 1972, CRC Press Inc.: Cleveland, pp. 225–253.

Primary Examiner—Joseph Golian
Attorney, Agent, or Firm—Bereskin & Parr

[57] **ABSTRACT**

A process for preparing a flavored dried fruit product having a flavor which does not substantially correspond to the natural flavor of the dried fruit is provided. As a first step, a dried fruit is treated with an acidulant being selected from the group consisting of tartaric acid, malic acid, citric acid, ascorbic acid, phosphoric acid, and fumaric acid in an amount and for a period of time which is sufficient to substantially remove the natural flavor of the dried fruit. As a second step, the treated dried fruit is then dehydrated to the desired moisture content. The dried fruit is treated during the first step or after the second step with a flavoring agent having a flavor which does not correspond to the natural flavor of the dried fruit. The flavoring agent is employed in an amount and for a period of time which is sufficient to impart to the dried fruit a flavor which is substantially the same as the flavoring agent.

7 Claims, No Drawings

PROCESS FOR PREPARING A DRIED FRUIT PRODUCT

BACKGROUND OF THE INVENTION

The invention relates to the field of dry fruits, and particularly, to a new dried fruit product having a flavor which does not substantially correspond to the natural flavor of the dried fruit, and a process for preparing the product.

Dried fruits such as raisins, prunes, apples, apricots, and peaches are recognized as highly nutritious food products. Raisins, for example, are a good source of iron, and they supply calcium, magnesium, potassium, phosphorous, B vitamins, protein and dietary fibre. (Foods and Food Production Encyclopedia, Considine, D.M. ed., Van Nostrand Reinhold Company, New York 1982, pages 1639–1942). Dried fruits are utilized as snack foods, confectionaries, etc., and as ingredients in foods such as snack foods, confectionaries, biscuits, cookies, cakes, dairy products, cereals, etc.

There is a need for dried fruit products which are inexpensive, have an appealing taste, aroma and texture, and are nutritious. Fruit leather products which are commercially available are expensive and contain ingredients such as sweeteners which make them nutritionally less desirable. Many of the sun dried or artificially dried fruits commercially available do not have an appealing taste, aroma or texture and therefore are not readily consumable as snack foods or readily incorporated into foods such as confectionaries, biscuits, cereals, etc.

There is also a need for a new and useful process which is capable of producing dried fruit products which retain more of their shape, size and natural nutrients, while imparting desirable taste, texture and aroma qualities to the dried fruit products.

U.S. Pat. No. 1,717,489 (issued Jun. 18, 1929 to Barlow) discloses a method of changing the flavor of dried fruits comprising combining the expressed juice of one fruit with another fruit which has been sun-dried or evaporated or which is in the process of drying. In one method disclosed a dry or drying fruit is immersed in the fruit juice of another fruit for a short time and then put again to dry; the process being repeated until the desired result is fully obtained. The method disclosed in the reference leaves much to be desired in terms of processing efficiency and processing costs and the tendency of the fruit juice to ferment over time may result in a product having an alcoholic taste. In addition, the absence of preservatives in the fruit juice and/or repeated applications of the fruit juice to the dry or drying fruit may introduce undesirable microorganisms into the dried fruit product shortening the shelf life of the product and more importantly, rendering the product harmful to consumers. Further, the repeated application of the fruit juice to the dry or drying fruit increases the sugar content resulting in a sticky product which is nutritionally less desirable. Repeated drying of the fruit also reduces the content of nutrients and volatiles in the fruit which effects the nutritional, and aroma and flavor qualities, respectively of the product.

SUMMARY OF THE INVENTION

The present invention provides dried fruit products, particularly raisins, having flavors which do not correspond to the natural flavor of the dried fruits and having desirable nutritional, texture and aroma qualities; and a process for preparing the dried fruit products. The improvements in the product attributes provided by the dried fruit products of the invention compared to prior art products is in texture, flavor, nutrition and aroma. The improvements are realized using the easily carried out process of the present invention.

Broadly stated, the present invention provides a process for preparing a flavored dried fruit product said process comprising:

(a) treating a dried fruit with an acidulant being selected from the group consisting of tartaric acid, malic acid, citric acid, ascorbic acid, phosphoric acid and fumaric acid, in an amount and for a period of time which is sufficient to substantially remove the natural flavor of the dried fruit;

(b) dehydrating the treated dried fruit to obtain a desired moisture content; and,

(c) treating the dried fruit during step (a) or after step (b) with a flavoring agent having a flavor which does not substantially correspond to the natural flavor of the dried fruit, said flavoring agent being employed in an amount and for a period of time which is sufficient to impart to the dried fruit a flavor which is substantially the same as the flavoring agent; and so forming a flavored dried fruit product having a flavor which is substantially the same as the flavor of said flavoring agent and having an outer surface which is substantially non-sticky whereby the flavored dried fruit product may be easily handled.

In one embodiment of the invention, a process for preparing a flavored raisin product is provided which process comprises a one step rehydration of raisins in a flavor solution comprising water, an acidulant, and a flavoring agent, and optionally comprising one or both of a sweetening agent and a colouring agent, said flavor solution being employed in an amount of about 10 to 100% by weight of final product, said acidulant being selected from the group consisting of tartaric acid, malic acid, citric acid, ascorbic acid, phosphoric acid and fumaric acid and being employed in an amount of 0.1 to 2.5% by weight of final product, said flavoring agent having a flavor which does not substantially correspond to the natural flavor of the raisins, said rehydration step being employed for a period of time to permit the flavor solution to stabilize in the raisins and to impart to the raisins a flavor which is substantially the same as the flavoring agent, and washing the rehydrated raisins to substantially remove any residual of the flavor solution on the outer surface or skin of the raisins, and a one step dehydration of the washed rehydrated raisins to obtain a desired moisture content, and so forming a flavored raisin product having a flavored meat comprising the flavor of the flavoring agent, and having an outer surface which is substantially non-sticky whereby the raisin product may be easily handled.

In a second preferred embodiment of the invention, a process for preparing a flavored raisin product is provided which process comprises treating raisins with an acidulant being selected from the group consisting of tartaric acid, malic acid, citric acid, ascorbic acid, phosphoric acid and fumaric acid, said acidulant being employed in an amount and for a period of time sufficient to provide raisins wherein the natural flavor of the raisins is substantially removed; dehydrating the so treated raisins to obtain a desired moisture content in the raisins, and treating the dehydrated raisins with a

flavoring agent having a flavor which does not substantially correspond to the natural flavor of the raisins, said flavoring agent being employed in an amount and for a period of time which is sufficient to impart to the raisins a flavor which is substantially the same as the flavoring agent; and so forming a flavored raisin product having a flavor which is substantially the same as the flavor of the flavoring agent and having an outer surface which is substantially non-sticky whereby the flavored raisin product may be easily handled.

The process of the invention, by employing minimal steps, economically decreases the time and ingredients required to obtain a dried fruit product with a desired taste, aroma and texture. The processing temperatures and times also make it possible to produce flavored dried fruit products having little or no loss of natural nutrients. Another feature of the present invention is the improved flow properties attained when the process is employed. Using conventional methods such as Barlow, the dried fruit products may form lumps which cause difficulties in handling, packaging, obtaining exact product weights, and incorporating into other food stuffs. It is also possible using the present invention to obtain a flavored dried fruit product which is more uniform in size and shape when compared to the prior art. In addition, the presence of the acidulant, significantly decreases the possibility of contamination and fermentation occurring.

The preferred process of the invention has a number of additional advantages. There is no heating of the flavoring agent so there is little or no loss of the volatile constituents of the flavoring agent which contribute to the flavor and aroma of the final product. Thus, the flavor and aroma of the flavoring agent is more readily retained in the flavored dried fruit product. The flavor and aroma will also penetrate the dried fruit on storage and provide the flavored dried fruit with a more well-developed flavor and aroma. In the preferred process of the invention, no sweetening agent is contacted with or applied to the dried fruit providing a more nutritionally desirable product. The absence of added sweetening agent in the preferred process also provides a product with superior flow properties which makes the product easy to handle, facilitating its use as a consumer product or in further processing as an ingredient in other food stuffs.

The invention also relates to flavored dried fruit products, particularly flavored raisin products produced by the processes of the invention. The flavored dried fruit products of the invention have a more appealing taste, aroma and texture than conventional dried fruit products and thus may be more readily consumable as snack foods or more readily incorporated into foods such as confectionaries, biscuits, cereals, etc.

DETAILED DESCRIPTION OF THE INVENTION

The dried fruits which may be flavored employing the processes of the invention include peach, apple, pear, raisins, prunes, apricots and cherries. Any dried fruit which contains between about 10% to 18% moisture may be employed. The process can be employed on whole or sectioned pieces of dried fruit.

Preferably the dried fruit is a raisin including Thompson seedless raisins, golden seedless raisins, muscat raisins or sultana raisins. The variety of raisin to be used in the processes of the invention will be determined by the desired end product color. Particularly preferred raisins to be used in the processes of the invention are Australian sultanas, VISTA TM raisins from California, seeded raisins from Australia and Dunas seedless raisins from Mexico.

The processing of many of the different dried fruits will require conditions specifically adapted to the dried fruit. The following description will be restricted to the conditions which are particularly suitable for preparing raisin products but it will be understood that persons skilled in the art, given the particular process conditions and steps set forth in this general description as well as in the Examples, could readily adapt the processes of the invention to other dried fruits.

As hereinbefore mentioned, in one embodiment of the invention, a process is provided for preparing a flavored raisin product which includes a one step rehydration of the raisins in a flavor solution. The amount of flavor solution employed is about 10 to 100% by weight of the final product, preferably about 15 to 20% by weight of the final product. The raisins and flavor solution may be mixed, without breaking up the raisins, in a mixer, for example a Hobart. The raisins are rehydrated in the flavor solution for a sufficient time to permit the flavor to stabilize in the raisins; in general, about 3 to 48 hours, preferably 4 to 6 hours, at about 70° to 120° F. The raisins and flavor solution may also be mixed in a steam kettle with a vacuum pump. The raisins and flavor solution are mixed without breaking up the raisins for 5 to 10 minutes, preferably 7 minutes, and then a vacuum of about 15" to 30", preferably 21" to 28" of mercury is applied for about 2 to 4 minutes.

The flavor solution contains water, an acidulant, a flavoring agent and, if desired, it may contain one or both of a sweetening agent or a colouring agent. As discussed above, the acidulant lowers the pH of the flavor solution, significantly decreasing possible contamination by undesirable microorganisms and fermentation. The acidulant also substantially removes the natural flavor of the dried fruit. In addition, the acidulant may also give the dried fruit product a tart taste and assist in breaking down any alkali film that may be on the outer surface of the raisins due to prior processing of the raisin which may inhibit absorption of the flavoring agent. Among the suitable acidulants which may be used in the processes of the invention are tartaric acid, malic acid, citric acid, ascorbic acid, phosphoric acid, or fumaric acid. The selection of a particular acidulant will be made with knowledge of the flavor compatibility of the acidulant with the particular dried fruit to be flavored and the flavoring agent. Thus, flavoring of a particular dried fruit or even a particular raisin using the processes of the invention will require a balancing of the flavoring agent and acidulant to achieve a desired result. For example, the preferred acidulant in the case of flavoring seeded raisins from Australia with cherry flavor is malic acid. Generally, the acidulant is present in an amount of 0.1 to 2.5% by weight of final product. The desired result as well as the nature of the acidulant will determine the actual amount used in any particular incident.

The flavoring agent used in the processes of the invention has a flavor which does not substantially correspond to the flavor of the fruit which is to be flavored in accordance with the processes of the invention. The flavoring agent may be one or more of a natural flavor or an artificial flavor or a combination of natural and artificial flavors. Natural flavors include fruit juices, concentrates and commercially available natural fla-

vors, for example Fries & Cino, Cherry Flavor No. 96243; Naarden's Natural Banana Flavor No. D014654; and BBA's Natural Lemon/Lime Flavor No. 5-9591. Among the artificial flavors that may be used in the process of the invention are Florasynth's Artificial Raspberry Flavor No. W388076, IFF Artificial Pineapple Flavor No. IC578122, BBA's Artificial Coconut Flavor No. M5, IFF's Artificial Pineapple Flavor No. IC578122 combined with BBA's Artificial Coconut Flavor M5 (Pina Colada), and FDO Artificial Passion Fruit Flavor No. 987114. Other natural or artificial fruit flavors that may be used in the process of the invention are orange, grapefruit, tangerine, guava and kiwi. Non-fruit flavors such as peanut butter and cinnamon, may also be used in the process of the invention. The flavoring agent when employed in the first embodiment of the process of the invention should be heat stable at the temperatures at which the process of the invention is carried out. Generally the flavoring agent is present in an amount of about 0.05 to 3% by weight of final product. The desired result as well as the nature of the flavoring agent will determine the actual amount used in any particular incident. The flavoring agent may additionally include vitamin and mineral premixes such as vitamin A, vitamin C, calcium, sodium, thiamine, riboflavin, vitamin B, vitamin B_2, etc.

If desired, the flavor solution may contain one or both of a sweetening agent or a coloring agent. The sweetening agent may be a natural sweetener such as sucrose, fructose or glucose or an artificial sweetening agent such as aspartame. Generally, for a natural sweetening agent an amount of about 0 to 15% by weight of the final product is employed. The coloring agent may be a natural or artificial coloring agent. The amount of coloring agent to be added can be determined by visual requirements.

The flavor solution may additionally contain a humectant such as glycerol and sorbitol. Sodium citrate may also be added to the flavor solution to provide a more tart taste, for example when preparing a lemon/-lime flavored dried fruit product.

The treated raisins in the first embodiment of the process of the invention are dehydrated using methods known in the art such as air-oven drying and vacuum drying. In particular, the treated raisins may be dehydrated in a home dehydrator, with adequate ventilation of about 20 m.p.h. wind velocity for a period of about 4 to 6 hours at about 125° to 175° F, preferably 5 to 6 hours at 145° to 150° F, till about 12% moisture remains in the product. The treated raisins prior to drying may also be subjected to a vacuum of about 15" to 30", preferably 21" to 28" of mercury for about 2 to 4 minutes to hasten the absorption of the flavor solution. If the flavor solution contains a sweetening agent it is advantageous to wash the treated raisins prior to drying.

In accordance with a preferred embodiment of the invention, a process is provided for preparing a flavored raisin product which comprises treating raisins with an acidulant being selected from the group consisting of tartaric acid, malic acid, citric acid, ascorbic acid, phosphoric acid and fumaric acid said acidulants being employed in an amount and for a period of time sufficient to provide raisins wherein the natural flavor of the raisin is substantially removed; dehydrating the so treated raisins to obtain a desired moisture content in the raisins, and treating the dehydrated treated raisins with a flavoring agent having a flavor which does not substantially correspond to the natural flavor of the raisins, said flavoring agent being employed in an amount and for a period of time which is sufficient to impart to the raisins a flavor which is substantially the same as the flavoring agent; and so forming a flavored raisin product having a flavor which is substantially the same as the flavor of the flavoring agent and having an outer surface which is substantially non-sticky whereby the flavored raisin product may be easily handled.

As a first step in the second preferred embodiment of the invention, the raisins are treated with an acidulant. The starting raisins are mixed with an aqueous solution containing the acidulant, in a mixer such as a Hobart mixer. The acidulant is employed in an amount, preferably 0.1 to 2.5% by weight of final product, and for a sufficient time to substantially remove the natural flavor of the raisins; in general about 2 to 3 hours, preferably 2.5 hours. The mixing is carried out at a temperature of about 20° C. to 50° C., preferably 20° C. If the starting raisins are coated with oil it is advantageous to wash the raisins prior to mixing to remove the oil coat. The acidulant treated raisins are then dehydrated to obtain a desired moisture content in the treated raisins. In particular, the raisins may be dehydrated in a home dehydrator, with adequate ventilation of about 20 m.p.h. wind velocity for a period of about 1 to 3 hours, preferably 2 hours, at 145° F. to 150° F., preferably about 145° F., until about 12 to 18% moisture, preferably 15% remains in the product. The raisins may be vacuum dried by subjecting to a vacuum of about 18" to 30", preferably 28" of mercury for about 1 to 3 hours, preferably 2 hours, to provide an internal product temperature of 110 to 160° F., preferably 110 to 120° F., until about 12 to 18% moisture, preferably 15% remains in the product. The acidulant treatment step and dehydration step may also be carried out in an apparatus such as a Rota-Cone Dryer and Processor (Paul 0. Abb Inc., Little Falls, N.J.)

The dehydrated treated raisins are mixed with a flavoring agent. The flavoring agent is employed in an amount and for a period of time sufficient to impart to the dehydrated raisins a flavor which is substantially the same as the flavoring agent. Generally, the dehydrated raisins and flavoring agent are mixed in a mixer such as a tumble mixer, to uniformly coat the dehydrated raisins. Generally an amount of flavoring agent which substantially coats the raisins is employed and in particular the flavoring agent may be present in an amount of about 0.5 to 3% by weight of the final product. In the preferred process, of the invention no sweetening agents are contacted or applied to the raisins.

The nature of the acidulants and flavoring agents which may be used in the preferred process of the invention are the same as the acidulants and flavoring agents hereinbefore described for the first embodiment of the process of the invention.

The dried raisins prepared according to the process of the invention can be used as a snack food or confectionery or an ingredient in products such as cakes, cookies, snack foods, confectioneries, dairy products, etc. The dried raisins may also be coated with chocolate.

The following non-limiting examples are illustrative of the present invention:

EXAMPLE 1

A cherry flavor solution containing 4.0g malic acid, 3.0g Fries & Cino Natural Cherry Flavor No. 96243 and 73.0g water was added to 400g of seeded raisins from Australia. The mixture was allowed to stand with inter-

mittent mixing, for 6 hours at room temperature (70° F.) to allow the solution to be absorbed into the raisins. The treated raisins were then dehydrated in a home dehydrator at 145° F. with adequate ventilation of about 20 m.p.h. wind velocity for a period of 5- to 6 hours to 12% moisture remaining in the product. The dried treated raisins were then cooled. The resultant product had a desirable cherry flavor.

EXAMPLE 2

The cherry flavor solution as described in Example 1 was added to 400g of seeded raisins from Australia and mixed in a Hobart mixer for about 10 minutes to allow uniform dispersion of the solution into the raisins. The mixture was then subjected to a vacuum of 21" to 28" of mercury for about 4 minutes to hasten the absorption of the solution. The treated raisins were then dehydrated as described in Example 1. The resultant product had a desirable cherry taste which was similar to the product prepared in accordance with the procedure as described in Example 1.

EXAMPLE 3

A strawberry flavor solution containing 1.20g of citric acid, 0.80g Florasynth Artificial Strawberry Flavor No. WL16103 and 78.0g of water was added to 400g of seeded raisins from Australia. Subsequent processing was carried out as described in Example 1 or Example 2 and the raisin products resulting for each process had a similar desirable strawberry taste.

EXAMPLE 4

A raspberry flavor solution containing 2.25g citric acid, 2.50g Florasynth Artificial Raspberry Flavor No. W388076 and 75.25g of water was added to 400g of seeded raisins from Australia. Subsequent processing was carried out as described in Example 1 or Example 2 and the raisin products resulting from each process had a similar desirable raspberry taste.

EXAMPLE 5

A banana flavor solution containing 1.00g citric acid, 7.00g Naarden Natural Banana Flavor No. DQ14654 and 72.00g of water was added to 400g of VISTA raisins from California. Subsequent processing was carried out as described in Example 1 or 2 and the raisin products resulting from each process had a similar desirable banana taste.

EXAMPLE 6

A pina colada flavor solution containing 3.0g citric acid, 4.0g IFF Artificial Pineapple Flavor No. IC5788122 o.4g BBA Artificial Coconut Flavor No. M%, and 72.6g of water was added to 400g of VISTA raisins from California. Subsequent processing was carried out as described in Example 1 or 2 and the raisin products resulting from each process had a similar desirable pineapple taste.

EXAMPLE 7

A lemon./lime flavor solution containing 5.0g citric acid, 0.5g sodium citrate, 1.5g BBA Natural Lemon/-Lime Flavor No. 5-9591 and 73.0g of water was added to 400g of Australian sultana raisins. Subsequent processing was carried out as described in Example 1 or 2 and the raisin products resulting from each process had a similar desirable lemon/lime taste.

EXAMPLE 8

A passion fruit flavor solution containing 3.0g citric acid, 0.8g F.D. & 0 Artificial Passion Fruit Flavor No. 987114, 8.0g passion juice concentrate and 68.2g of water was added to 400g of VISTA raisins from California. Subsequent processing was carried out as described in Example 1 or 2 and the raisin products resulting from each process had a similar desirable passion fruit taste.

EXAMPLE 9

A 2000g sample of Australian sultana raisins was treated with hydrogenated vegetable oil (0.5%) and then washed with hot water and dried. The washed raisins (2060g) were treated with 250ml of a 10% anhydrous citric acid solution for 2 hours and the resulting acidified raisins (2310g) were then dehydrated in a home dehydrator at 145° F. with adequate ventilation of about 20 m.p.h. wind velocity for a period of 3 hours. The resulting dehydrated raisin product (1970-1980g) was substantially free of any natural raisin flavor. A 0.4% flavor solution of Bush Brooke Allen Flavor #5-9591 was added to coat the dehydrated raisin product. The process was repeated using a 2000g sample of Thompson seedless raisins. An Orange Flavored raisin product was prepared employing the described process, using 2000g samples of each of Australian sultana raisins and Thompson seedless raisins and 250ml of an 8% anhydrous citric acid solution and a 0.7% flavor solution of cold pressed California orange oil (Seeley).

As a comparison, the process described in U.S. Pat. No. 1,717,489 to Barlow was also used to prepare lemon flavored and orange flavored raisins. In particular, 2000g samples of Australian sultana raisins and Thompson seedless raisins were washed with hot water and dried. The washed raisin samples (2060g) were then soaked in 250ml of either fresh lemon juice squeezed form Florida lemons or fresh orange juice squeezed from Swaziland oranges and then dehydrated in a home dehydrator at 145° F with adequate ventilation of about 20 m.p.h. wind velocity for a period of 3 hours. The resulting raisins retained their natural flavor characteristics.

The raisin product produced by the process of the invention had a superior orange or lemon flavor when compared to the raisins produced by the process disclosed in Barlow. No difference in the color of the raisin product of the invention and the raisins produced by the Barlow process was observed.

In the case of the orange flavored raisin product of the invention, it had a less sticky texture than the raisins produced using the Barlow process.

The sugar and acid content of the raisin products of the invention and the raisins produced using the Barlow process were calculated.

As shown in Table 1, the orange and lemon flavored raisins produced using the Barlow process have a lower acid content and a higher sugar content when compared to the orange and lemon flavored raisin product of the present invention. If the acid content of the Barlow raisins were increased by soaking the raisins in additional orange or lemon juice, this would necessarily substantially increase the sugar content of the raisins, which is not desirable.

TABLE 1

	Acid Content (%)	Sugar Content (%)
Invention		
Orange raisin product	1	71.2%*

TABLE 1-continued

	Acid Content (%)	Sugar Content (%)
Lemon raisin product Barlow	1.4	71.2%
Orange Raisins	0.08–0.28**	72%*
Lemon Raisins	0.72–1.05***	71.35–71.65

*71.2% is total sugar content of raisins from General Foods Specifications. Minimum sugar content of orange juice is 6.4%. (The Structure and Composition of Foods, details re publication p. 690).

$250\ g \times \frac{.64}{100} = 0.8\%$

**Minimum Citric Acid Content of Orange Juice is 0.64%. (The Structure and Composition of Foods, p. 690)

$250\ g \times \frac{.64}{100} = 1.6/2000 = 0.08\%$ acidity

***Minimum Citric Acid Content of Lemon Juice is 5.74%. (The Structure and Composition of Foods, Vegetables, Legumes and Fruits, Vol. II, Winton, A.L., and K. B. Winton, John Wiley & Sons, Inc., London, p. 704).

$250\ g \times \frac{5.74}{100} = 14.35/2000 = .007175 = 0.72\%$

EXAMPLE 10

A 2000g sample of Australian sultana raisins with hydrogenated vegetable oil coating (0.5%) were washed with hot water and dried. The washed raisins were treated with 250ml of an 8% malic acid solution for 2 hours and then dehydrated in a home dehydrator at approximately 145° F. with adequate ventilation of about 20 m.p.h. wind velocity for a period of 3 hours. The raisins may alternatively be dehydrated by vacuum drying by subjecting to a vacuum of about 28" of mercury for a period of 2 hours to provide an internal raisin temperature of approximately 110 to 160° F. The resulting dehydrated raisin product was substantially free of any natural raisin flavor. A 1.0% solution of Natural Cherry Flavor #77742 from F & C International was added to coat the dehydrated raisin product.

EXAMPLE 11

A passion fruit raisin product was prepared employing the process described in Example 10 using 250ml of an 8% citric acid solution and a 0.6% solution of Artificial Flavor #987114 from Fritzsche, Dodge & Olcott.

EXAMPLE 12

A pina colada raisin product was prepared employing the process described in Example 10 using 250ml of 0.8% citric acid and a solution containing 1.0% Artificial Pineapple #IC5-78122 from International Flavor & Fragrances and 0.1% Artificial Coconut #M5 from Bush Brooke Allen.

EXAMPLE 13

A banana flavored raisin product was prepared employing the process described in Example 10 using 250ml of 0.8% citric acid and a 0.5% solution of Natural Banana Flavor #82641 from F & C International.

EXAMPLE 14

A strawberry flavored raisin product was prepared employing the process described in Example 10 using 250ml of 1% malic acid and a solution of Strawberry No. 987148 from FD & 0 International.

While certain representative embodiments of the invention have been described herein for the purpose of illustration, it will be apparent to those skilled in the art that modifications therein may be made without departing from the spirit and scope of the invention.

We claim:

1. A process for preparing a flavored dried fruit product said process comprising:

(a) treating a dried fruit with an acidulant being selected from the group consisting of tartaric acid, malic acid, citric acid, ascorbic acid, phosphoric acid and fumaric acid, in an amount and for a period of time which is sufficient to substantially remove the natural flavor of the dried fruit;

(b) dehydrating the treated dried fruit to obtain a desired moisture content; and,

(c) treating the dried fruit during step (a) or after step (b) with a flavoring agent having a flavor which does not substantially correspond to the natural flavor of the dried fruit, said flavoring agent being employed in an amount and for a period of time which is sufficient to impart to the dried fruit a flavor which is substantially the same as the flavoring agent;

and so forming a flavored dried fruit product having a flavor which is substantially the same as the flavor of the flavoring agent and having an outer surface which is substantially non-sticky whereby the flavored dried fruit product may be easily handled.

2. A process for preparing a flavored raisin product comprising a one step rehydration of raisins in a flavor solution comprising water, an acidulant, and a flavoring agent, and optionally comprising one or both of a sweetening agent and a colouring agent, said flavor solution being employed in an amount of about 10 to 100% by weight of final product, said acidulant being selected from the group consisting of tartaric acid, malic acid, citric acid, ascorbic acid, phosphoric acid and fumaric acid and being employed in an amount of 0.1 to 2.5% by weight of final product, said flavoring agent having a flavor which does not substantially correspond to the natural flavor of the raisins, said rehydration step being employed for a period of time to permit the flavor solution to stabilize in the raisins and to impart to the raisins a flavor which is substantially the same as the flavoring agent, washing the rehydrated raisins to substantially remove any residual of the flavor solution on the outer surface or skin of the raisins, and a one step dehydration of the washed rehydrated raisins to obtain a desired moisture content, and so forming a flavored raisin product having a flavored meat comprising the flavor of the flavoring agent, and having an outer surface which is substantially non-sticky whereby the raisin product may be easily handled.

3. A process for preparing a flavored raisin product, said process comprising treating raisins with an acidulant being selected from the group consisting of tartaric acid, malic acid, citric acid, ascorbic acid, phosphoric acid and fumaric acid, said acidulant being employed in an amount and for a period of time sufficient to provide raisins wherein the natural flavor of the raisins is substantially removed; dehydrating the so treated raisins to obtain a desired moisture content in the raisins, and treating the dehydrated raisins with a flavoring agent having a flavor which does not substantially correspond to the natural flavor of the raisins, said flavoring agent being employed in an amount and for a period of time which is sufficient to impart to the raisins a flavor which is substantially the same as the flavoring agent; and so forming a flavored raisin product having a flavor which is substantially the same as the flavor of the flavoring agent and having an outer surface which is substantially

non-sticky whereby the flavored raisin product may be easily handled.

4. A process as claimed in claim **3**, wherein the acidulant is employed in an amount of 0.1 to 2.5% by weight of final product and the flavoring agent is employed in an amount of .05 to 3% by weight of final product.

5. A process as claimed in claim **3** or **4** wherein the flavoring agent is one or more of a natural and an artificial cherry, strawberry, raspberry, banana, pineapple, coconut, lemon/lime, orange, grapefruit, tangerine, guava, kiwi, or passion fruit flavor.

6. A flavored raisin product produced by a process comprising treating raisins with an acidulant being selected from the group consisting of tartaric acid, malic acid, citric acid, ascorbic acid, phosphoric acid and fumaric acid, said acidulant being employed in an amount and for a period of time sufficient to provide so treated raisins wherein the natural flavor of the raisins is substantially removed; dehydrating the so treated raisins to obtain a desired moisture content in the raisins, and treating the dehydrated raisins with a flavoring agent having a flavor which does not substantially correspond to the natural flavor of the raisins, said flavoring agent being employed in an amount and for a period of time which is sufficient to impart to the raisins a flavor which is substantially the same as the flavoring agent; and so forming a flavored raisin product having a flavor which is substantially the same as the flavor of the flavoring agent and having an outer surface which is substantially non-sticky whereby the flavored raisin product may be easily handled.

7. A process as claimed in claim **1**, wherein no sweetening agent is contacted with or applied to the dried fruit.

* * * * *

EXHIBIT 2

Patented June 18, 1929. 1,717,489

UNITED STATES PATENT OFFICE.

BRONSON BARLOW, OF MADISON, WISCONSIN.

FRUIT PRODUCT AND METHOD OF MAKING THE SAME.

No Drawing. Application filed August 4, 1924. Serial No. 729,970.

My invention relates to sun-dried and evaporated fleshy fruits for use as human food. The process comprises combining the expressed juice of one fruit with another fruit which has been sun-dried or evaporated or which is in process of such drying.

The dried fruits employed in my process are the dried fruits of commerce as apples, prunes, raisins, and the like. Any fleshy fruit which on pressure yields a desirable juice may be used to furnish the fruit juice. Agreeable combinations will usually result on combining fruits of opposite or unlike qualities, as the highly flavored with the insipid and the sour with the sweet.

Citrous fruits, especially the lemon and the lime, are well suited to furnish juice to combine with prunes and raisins. The juice of sour grapes is ideal for combination with raisins. Such juice changes the raisin into a raisin-currant or grape-raisin superior to the imported currant in size, sweetness and flavor and superior to the raisin in acidity and flavor and with as great a range of flavors as is found among all the varieties of grapes whether of European or American origin.

Having thus indicated the range of materials and the basis of their selection, I will proceed to describe the methods which I have invented for their combination.

Fruits are sun-dried or evaporated to the end or toward the end of the usual process. The expressed fruit juice is now sprayed upon the dried or partly dried fruit and the drying is continued. The spraying may be repeated with intervals of drying between until the desired result is obtained. A power tank sprayer with a clean wooden tank may be used or any other convenient form of sprayer.

Instead of applying the expressed fruit juice in the form of spray, I may immerse the dry or drying fruit in the fruit juice for a short time and then put it again to dry, repeating the process until the desired result is fully obtained. Either process may thus be applied to fruits undergoing the primary or initial drying from the state and condition of freshly gathered ripe fruit.

My process likewise can be applied at any convenient time and at any place near to or distant from the place where the dried fruit was grown. For example, raisins in bulk can be shipped from California to the areas producing table grapes in Michigan or in New York and there the raisins can be drenched with or immersed in grape juice newly pressed, from say, Concord grapes. The moistened raisins can then be dried in the usual form of fruit evaporators and the process repeated if desired.

Dried prunes may be handled in the same manner. Prunes may be heated with juice pressed from lemons, producing a prune of superior quality and utilizing a grade of lemons left in sorting the fruit for market.

Citrous fruits as the lime, the lemon and the grape fruit have not hitherto been offered as dried fruits. Indeed it would be difficult to dry them. The process which I have invented makes these fruits available at least in combination with other dried fruits, as apples, pears and prunes.

For certain purposes, as for cookery, the fruit juice remaining on the soaked raisins or prunes may be dried there and the finished product will be more or less sticky. As a confection, however, it may be desirable to remove such excess juice from the soaked fruit by washing with water before drying. I may mix the expressed juice of one fruit with the juice of another to combine in one product desired properties of two or more fruits.

Dried prunes, soaked in lemon juice and dried again, form lemon-prune, one of the choicest products of the present invention. The prune so treated retains its attractive form, color, texture, and sweetness and the juice of the lemon adds a tonic bitterness, a refreshing citric sourness and a natural lemon flavor. Moreover, the juice of the lemon enriches the prune in water soluble vitamines so that the lemon-prune is valuable on shipboard and in the diet of the people.

I claim:

1. A method of making a synthetic dried whole fruit, comprising subjecting an uncooked fruit of one kind to drying action, drenching the dried or partially dried fruit with the expressed uncooked juice of another kind of fruit and subjecting the treated fruit to further drying action.

2. Synthetic dried currants consisting of whole raisins containing juice of citrous fruit.

3. A synthetic dried whole fruit of the raisin type comprising a whole raw fruit of said type, dried and containing the dried residue of raw juice of another fruit.

4. A synthetic dried whole fruit of the raisin type comprising a whole raw fruit of said type, dried and containing the dried residue of the raw juice of a citrous fruit.

In witness whereof, I have hereunto subscribed my name.

BRONSON BARLOW.

EXHIBIT 3

UNITED STATES DEPARTMENT OF COMMERCE
Patent and Trademark Office

Address : COMMISSIONER OF PATENTS AND TRADEMARKS
Washington, D.C. 20231

SERIAL NUMBER	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.
07/530,863	05/31/90	MAZIN	J 027.010B

EXAMINER
GOLIAN, J

ART UNIT	PAPER NUMBER
132	

DATE MAILED: 10/31/90

ROGERS, BERESKIN & PARR
BOX 401
40 KING STREET WEST
TORONTO, ONTARIO, CANADA
M5H 3Y2

This is a communication from the examiner in charge of your application.
COMMISSIONER OF PATENTS AND TRADEMARKS

☒ This application has been examined ☐ Responsive to communication filed on _____ ☐ This action is made final.

A shortened statutory period for response to this action is set to expire 3 month(s), 0 days from the date of this letter. Failure to respond within the period for response will cause the application to become abandoned. 35 U.S.C. 133

Part I THE FOLLOWING ATTACHMENT(S) ARE PART OF THIS ACTION:

1. ☒ Notice of References Cited by Examiner, PTO-892.
2. ☐ Notice re Patent Drawing, PTO-948.
3. ☐ Notice of Art Cited by Applicant, PTO-1449.
4. ☐ Notice of Informal Patent Application, Form PTO-152
5. ☐ Information on How to Effect Drawing Changes, PTO-1474.
6. ☐ _____.

Part II SUMMARY OF ACTION

1. ☒ Claims 1-6 are pending in the application.

   Of the above, claims _____ are withdrawn from consideration.

2. ☐ Claims _____ have been cancelled.
3. ☐ Claims _____ are allowed.
4. ☒ Claims 1-6 are rejected.
5. ☐ Claims _____ are objected to.
6. ☐ Claims _____ are subject to restriction or election requirement.
7. ☐ This application has been filed with informal drawings under 37 C.F.R. 1.85 which are acceptable for examination purposes.
8. ☐ Formal drawings are required in response to this Office action.
9. ☐ The corrected or substitute drawings have been received on _____. Under 37 C.F.R. 1.84 these drawings are ☐ acceptable; ☐ not acceptable (see explanation or Notice re Patent Drawing, PTO-948).
10. ☐ The proposed additional or substitute sheet(s) of drawings, filed on _____. has (have) been ☐ approved by the examiner; ☐ disapproved by the examiner (see explanation).
11. ☐ The proposed drawing correction, filed _____, has been ☐ approved; ☐ disapproved (see explanation).
12. ☐ Acknowledgement is made of the claim for priority under U.S.C. 119. The certified copy has ☐ been received ☐ not been received ☐ been filed in parent application, serial no. _____ ; filed on _____.
13. ☐ Since this application apppears to be in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under Ex parte Quayle, 1935 C.D. 11; 453 O.G. 213.
14. ☐ Other

EXAMINER'S ACTION

PTOL-326 (Rev.9-89)

The furnished specification, claims and abstract are a poor machine copy. Of the many defects, the office copy has a black line running through the text on each page. Applicants are required to furnish a substitute copy and request cancellation of the furnished original. No new matter can properly be introduced.

The comma (,) in Table 1 should be changed to a period (.).

Forms of the word "flavour" throughout the Abstract, specification and claims should be changed to flavor to conform to normal usage in this country. See, for example, page 1, line 6.

The following is a quotation of 35 U.S.C. § 103 which forms the basis for all obviousness rejections set forth in this Office action:

> A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.
>
> Subject matter developed by another person, which qualifies as prior art only under subsection (f) or (g) of section 102 of this title, shall not preclude patentability under this section where the subject matter and the claimed invention were, at the time the invention was made, owned by the same person or subject to an obligation of assignment to the same person.

Claims 1-6, all the claims in the case, are rejected under 35 U.S.C. § 103 as being unpatentable over Barlow in view of the

Furia text and Agarwala.

Consistent with that taught in the instant specification in the paragraph bridging pages 1 and 2, Barlow teaches "a method of changing the flavour of dried fruits comprising combining the expressed juice of one fruit with another fruit which has been sun-dried evaporated or which is in the process of drying." Barlow is specific to raisins set forth in some of the claims as see, for example, page 1, line 9. Dried fruits are immersed in a juice to incorporate the flavor as see, for example, page 1, the paragraph bridging the two columns.

Barlow is deficient in not disclosing the use of accessory ingredients, e.g. acids. However, the claimed ingredients are known ingredients contributing their expected functional effect to the total composition.

The Furia text discloses that the claimed acids are known food additives of known properties. The text reference discloses that the claimed acids are common food additives.

Argawala discloses the preparation of infused fruit products. Sugars taught on by page 9, first complete paragraph of the specification are taught in the reference in column 4, penultimate paragraph. Acids of the type claimed are taught in column 4, last paragraph. Fruit juices, taught on page 8, lines 12 et seq. of the instant specification, are also taught in the reference at column 4, lines 66-68. Adjuvants such as color and

flavor taught in the instant specification are disclosed in the applied reference at column 5, first complete paragraph.

To use the additives of the secondary references in the relation of Barlow for their expected functionality taught by the secondary references is considered a routine matter well within the ordinary skill of one in the art. The claims are considered to recite nothing more than an obvious recipe and see the pertinency of In re Levin, 84 USPQ 232.

It is noted that applicants assert in the specification, e.g. page 3, lines 4-9 and some of the claims that the treatment with acids "substantially remove the natural flavour of the dried fruit." Applicants' assertion seems highly doubtful. For example, the specification teaches in Example 9 a sorption process with a limited amount of acids. There is no good explanation why such minimal acid treatment would effect a removal of flavors. The applied Agarwala teaches an acid treatment without teaching the use of such acid to remove flavors. It is considered that applicants' assertion is without support and ignores the contribution of the acid to the total flavor profile.

Apart from the above, it is pointed out that obviousness does not require absolute predictability. The use of food acids, such as here claimed, is common and to use such acids for the expected functionality in the claimed environment would be

routine and well within the ordinary skill of one in the art.

The two step process recited in some of the claims is not considered patentably significant. Barlow discloses a sequential treatment and to vary the process of Barlow for separate treatments with acid and flavor would be routine and well within the ordinary skill of one in the art.

The comparative showing in Example 9 has been considered but is not considered particularly pertinent to the full scope of that which is claimed. Moreover, that comparative showing does not address the rejection of the claims as applied.

Features variously recited in the different claims are considered obvious features or control limitations well within the determination of the ordinary worker in the art.

Claim 6, drawn to the product, is rejected under 35 U.S.C. § 103 as being unpatentable over Barlow.

Any difference in the product claimed and the product of the prior art is at best a difference in degree and not in kind. The recitation that the product is made by a new process, if the process were indeed new and patentable, does not impart patentability to an otherwise unpatentable product.

The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

Humprey is generally cumulative to the applied Barlow. The Japanese patent shows the functionality of vacuum in impregnating

materials and shows impregnating fruit with sugars, organic acids, etc.

No claim is allowed.

Any inquiry concerning this communication should be directed to Joseph Golian at telephone number (703) 308-3830.

Golian/ad
October 26, 1990
October 30, 1990

JOSEPH GOLIAN
PRIMARY EXAMINER
ART UNIT 132

TO SEPARATE, HOLD TOP AND BOTTOM EDGES, SNAP–APART AND DISCARD CARBON

FORM PTO-892 (REV. 3-78) U.S. DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE	SERIAL NO. 530863	GROUP ART UNIT 132	ATTACHMENT TO PAPER NUMBER
NOTICE OF REFERENCES CITED	APPLICANT(S)		

U.S. PATENT DOCUMENTS

*		DOCUMENT NO.	DATE	NAME	CLASS	SUB-CLASS	FILING DATE IF APPROPRIATE
	A	1609720	12/1926	Humphrey	426	640	
	B	1717489	6/1929	Barlow	426	640	
	C	4542033	9/1985	Agarwala	426	640x	
	D						
	E						
	F						
	G						
	H						
	I						
	J						
	K						

FOREIGN PATENT DOCUMENTS

*		DOCUMENT NO.	DATE	COUNTRY	NAME	CLASS	SUB-CLASS	PERTINENT SHTS. DWG	PERTINENT PP. SPEC.
	L	6216641	9/1986	JAPAN	MOMOSE	426	640	—	all
	M								
	N								
	O								
	P								
	Q								

OTHER REFERENCES (Including Author, Title, Date, Pertinent Pages, Etc.)

R Furia, CRC Handbook of Food Additives, Vol. I, 1972, CRC Press Inc.: Cleveland, pages 225–253. 14

S

T

U

EXAMINER	DATE
JOSEPH GOLIAN PRIMARY EXAMINER ART UNIT 132	10-10-90

* A copy of this reference is not being furnished with this office action.
(See Manual of Patent Examining Procedure, section 707.05 (a).)

EXHIBIT 4

GP 132

Docket No.: 027-010B PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of :
:
MAZIN et al :
:
Serial No. 07/530,863 : Group Art Unit: 132
:
Filed: May 31, 1990 : Examiner: Joseph Golian
:
For: PROCESS FOR PREPARING A DRIED FRUIT PRODUCT

AMENDMENT

Honorable Commissioner of
Patents and Trademarks
Washington, D. C. 20231

Sir:

This is responsive to the Examiner's official letter dated October 31, 1990. The Examiner is respectfully requested to substitute the enclosed copy of the application for the copy of the application originally filed and presently of record, and to cancel the copy of the application originally filed. The undersigned verifies that the substitute copy of the application submitted herewith contains no new matter.

IN THE CLAIMS:

Please add the following claim 7:

--7. A process as claimed in claim 1, wherein no sweetening agent is contacted with or applied to the dried fruit.--

REMARKS

The Examiner requested a substitute copy of the application due to the poor machine copy of the furnished original. Accordingly, Applicants have enclosed a substitute copy of the application. In the substitute copy of the

application, Applicants have made the amendments to Table I and corrected the word "flavour" throughout the application as requested by the Examiner. These changes do not involve the introduction of any new matter into the application. Entry of the substitute copy of the application is therefore believed to be in order and is respectfully requested.

By the present Amendment, claim 7 has been added. Claim 7 relates to a preferred embodiment of the presently claimed process wherein no sweetening agent is contacted with or applied to the dried fruit. Support for claim 7 may be found throughout the specification, for example, at page 5, lines 24-27. Since this amendment does not involve any introduction of new matter, entry is believed to be in order and is respectfully requested.

The Examiner has rejected claims 1-6 under 35 U.S.C. 103 as being unpatentable over Barlow in view of the Furia text and Agarwala. However, as will be set forth in detail below, it is submitted that the presently claimed invention is nonobvious over and patentably distinguishable from the combined teachings of Barlow, Furia and Agarwala.

More particularly, claim 1 recites a process for preparing a flavored dried fruit product. The process comprises a first step of treating a dried fruit with an acidulant selected from a specified group in an amount and for a period of time which is sufficient to substantially remove the natural flavor of the dried fruit. The treated dried fruit is then dehydrated to obtain a desired moisture content. Additionally, during the acidulant-treatment step or after the dehydration step, the dried fruit is treated with a flavoring agent having a flavor which does not substantially correspond to the natural flavor of the dried fruit. The flavoring agent is employed in an amount and

for a period of time which is sufficient to impart to the dried fruit a flavor which is substantially the same as the flavoring agent. The resulting flavored dried fruit product has a flavor which is substantially the same as the flavor of the flavoring agent and has an outer surface which is substantially non-sticky, whereby the flavored dried fruit product may be easily handled. Claims 2-5 relate to preferred embodiments of the process and claim 6 recites the flavored raisin product produced by a preferred embodiment of the process.

The Examiner noted in the Official Action that Applicants have stated in the application at page 1 that Barlow teaches "a method of changing the flavor of dried fruits comprising combining the expressed juice of one fruit with another fruit which has been sun dried or evaporated or which is in the process of drying." The Examiner also stated that Barlow is specific to raisins, and that Barlow teaches dried fruits immersed in a juice to incorporate the flavor. The Examiner acknowledged that Barlow is deficient in not disclosing the use of accessory ingredients, e.g. acids, but asserted that the claimed ingredients are known ingredients contributing their expected functional effect to the total composition. The Examiner was of the opinion that use of the additives of the secondary references in the relation of Barlow for their expected functionality taught by the secondary references is considered a routine matter well within the ordinary skill of one in the art. The Examiner concluded that the claims recite nothing more than an obvious recipe and cited In re Levin, 84 USPQ 232.

Applicants submit that Barlow teaches the repeated exposure of the dried or drying fruit to the expressed fruit juice. In one embodiment, Barlow suggests that spraying of the drying fruit

be repeated at intervals until the desired result is obtained. In another embodiment, Barlow suggests that repeated immersion of the fruit can be carried out during the drying process. In addition, Barlow also suggests that the excess juice can be removed from the soaked fruit by washing with water before drying.

Thus, Barlow teaches a process which is cumbersome, inefficient and unsanitary. The Barlow process is cumbersome and inefficient because it requires repeated application of the expressed fruit juice to the external surface of the dried or drying fruit. In contrast, Applicants claim a process including a one step rehydration and a one step dehydration, which process is advantageous over Barlow.

Applicants submit that the process of the invention, by employing minimal steps, economically decreases the time and ingredients required to obtain a dried fruit product with a desired taste, aroma and texture. The processing temperatures and times also make it possible to produce flavored dried fruit products having little or no loss of natural nutrients. Another feature of the present invention is the improved flow properties attained when the process is employed. Using conventional methods such as taught by Barlow, the dried fruit products may form lumps which cause difficulties in handling, packaging, obtaining exact product weights, and incorporating the products into other food stuffs. It is also possible using the present invention to obtain a flavored dried fruit product which is more uniform in size and shape when compared to the product obtained by the process taught by Barlow. In addition, the use of the acidulant in the process of the present invention not only

removes the natural flavor of the dried fruit but also significantly decreases the possibility of contamination and fermentation in the fruit product.

A preferred process of the invention as set forth in claim 3 has a number of additional advantages. Because the flavoring agent is employed after the dehydration step, there is no heating of the flavoring agent. Consequently, there is little or no loss of the volatile constituents of the flavoring agent which contribute to the flavor and aroma of the final product. Thus, the flavor and aroma of the flavoring agent is more readily retained in the flavored dried fruit product. The flavor and aroma will also penetrate the dried fruit on storage and provide the flavored dried fruit with a more well-developed flavor and aroma. In the preferred process of the invention recited in claim 7, no sweetening agent is contacted with or applied to the dried fruit, thereby providing a more nutritionally desirable product. The absence of an added sweetening agent in the preferred process also provides a product with superior flow properties which makes the product easy to handle, facilitating its use as a consumer product or in further processing as an ingredient in other food stuffs.

It is further submitted that in the method taught by Barlow, most of the juice being applied to the dried fruit would dry on the outer surface of the fruit. Washing the fruit, as suggested by Barlow in combination with this method, would likely result in a substantial loss of the flavor being contributed by the expressed fruit juice, as well as significant waste of the juice. In contrast, Applicants apply the flavoring agent to the dried fruit which has been acidulated to substantially remove the natural flavor of the dried fruit. The flavoring agent is used

in a controlled amount and for a period of time sufficient to impart to the dried fruit a flavor which is substantially the same as the flavoring agent, and which does not substantially retain the flavor of the dried fruit. Applicants submit that the process of the present invention, in using controlled amounts of the flavoring agent in the rehydration process, significantly reduces waste of these ingredients.

In the present invention, the meat of the dried fruit is flavored by allowing the flavor solution to infuse through the outer surface of the dried fruit, and to permeate and stabilize in the dried fruit. The result is a food product in which the flavoring agent is contained substantially within the meat of the fruit and it is non-sticky to the touch. Applicants submit that the repeated exposure process taught by Barlow teaches directly away from the flavor stabilization process of the present application.

As the Examiner noted, Barlow is deficient in not disclosing the use of accessory ingredients like acids to contribute to the process. The Examiner states that the Furia text discloses that the claimed acids are known food additives of known properties. Applicants submit that, while the use of acids is known in the food additive industry, it is not obvious to use acids in the specific step to prepare the meat of the dried fruit product for rehydration. Applicants submit that Barlow in view of Furia does not teach or suggest the use of the acidulation step as recited in the present claims or in order to substantially remove the flavor of dried fruit and to prepare a dried fruit product with the properties of the dried fruit product of the invention.

The Examiner states that the Agarwala patent discloses the preparation of infused fruit products and that the sugars, acids, fruit juices and adjuvants such as color and flavor taught therein are the same as those taught in the instant application. Applicants submit that Agarwala teaches the use of these agents in a process involving a cooking syrup which is applied to fresh fruit pieces. Thus, there is no teaching or suggestion in Agarwala relating to the preparation of a dried fruit product as claimed in the present invention.

It is well settled that obviousness under 35 U.S.C. 103 cannot be established by combining the teachings of the prior art to produce the claimed invention absent some teaching, suggestion or incentive supporting the combination, In re Geiger, 2 USPQ 2d 1276 (Fed. Cir. 1987). Similarly, the Examiner cannot pick and choose among the individual elements of assorted prior art references to recreate the claimed invention; the Examiner has the burden to show some teaching or suggestion in the references to support their use in the particular claimed combination, Smithkline Diagnostics Inc. v. Helena Laboratories Corp., 8 USPQ 2d 1468 (Fed. Cir. 1988).

In the present case, neither Barlow nor Furia nor Agarwala teach or suggest the improvements provided by the process and product of the present invention as discussed above. Thus, the teaching, suggestion or incentive required by In re Geiger, supra, is missing. The Examiner therefore has not met the burden of showing some teaching or suggestion in the references to support their use in rendering the presently claimed invention obvious. It is therefore submitted that the presently claimed

invention is nonobvious over and patentably distinguishable from the combined teachings of Barlow, Furia and Agarwala and that the rejection under 35 U.S.C. Section 103 has been overcome.

The Examiner has noted that Applicants assert in the specification, and in some of the claims, that treatment with acids "substantially removes the natural flavor of the dried fruit." The Examiner stated that Applicants' assertion is considered to be without support and that Applicants ignore the contribution of the acid to the total flavor profile. The Examiner stated that Applicants' assertion seems highly doubtful and referred to example 9 which the Examiner states teaches a sorption process with a limited amount of acids.

However, Example 9 teaches a process involving the treatment of raisins with a 10% anhydrous citric acid solution for 2 hours. It is submitted that when the amount and period of application of acid are taken into account, the acid treatment is not "minimal" as asserted by the Examiner. Furthermore, Applicants have tasted raisins so treated and have found that they were substantially free of any natural raisin flavor. Moreover, it is well settled that it is incumbent upon the Patent Office to explain why it doubts the truth or accuracy of any statement in a supporting disclosure and to backup assertions of its own with acceptable evidence or reasoning which is inconsistent with a contested statement, In re Marzocchi, 169 U.S.P.Q. 367 (CCPA 1971). The Examiner has not provided any acceptable evidence or reasoning which is inconsistent with the statements set forth in the present application concerning the acidulant treatment substantially removing the natural flavor of the dried fruit.

The Examiner pointed out that the use of food acids, such as those claimed herein, is common and to use such acids for the expected functionality in a claimed environment would be routine and within the ordinary skill of one in the art. The Examiner further stated that the two step process recited in some of Applicants' claims are not considered patentably significant and that variation in the process of Barlow for separate treatments with acid and flavor would be routine and well within the ordinary skill of one in the art. Applicants respectfully submit that the present invention is not a mere variation of the process of Barlow. Barlow teaches the repeated drenching of a dried fruit with flavoring, followed by rinsing and further drying. Barlow's method does not involve substantially removing the natural flavor of the dried fruit. In contrast, Applicants' invention relates to a process of acidulating dried fruit which results in substantial removal of the dried fruit flavor.

The Examiner has stated that the comparative showing in example 9 has been considered but was not found to be particularly pertinent to the scope of that which is claimed, and that the comparative showing does not address the rejection of the claims as applied. Applicants respectfully submit that the data in example 9 is pertinent to the scope of what is claimed and addresses the rejection of the claims. Example 9 demonstrates that using the process of the invention results in a dried fruit product with significantly different properties i.e. superior flavor, less sticky texture, lower sugar content, etc. It is well settled that an Applicant relying on comparative tests to rebut a prima facie case of obviousness must compare his claimed invention to the closest prior art, In re DeBlauwe, 222 U.S.P.Q. 191 (Fed. Cir. 1984). In example 9, Applicants provide

a direct comparison between the presently claimed invention and the teachings of the closest prior art relied upon by the Examiner, namely, Barlow. Thus, the comparisons set forth in example 9 rebut any prima facie case of obviousness based on the teachings of Barlow.

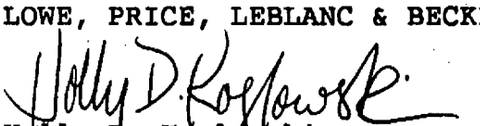
The Examiner has stated that any difference in the product claimed and the product in the prior art is at best a difference in degree and not in kind and that the recitation that the product is made by a new process, does not impart patentability to an otherwise unpatentable product. Applicants submit that there are significant differences between the product of Barlow and the product of the present application. Example 9 set forth in the application demonstrates these differences. As discussed supra, the food product of the present invention has flavoring which permeates throughout the outer surface and the meat, without leaving the surface sticky to the touch. The product of the present invention thus has superior flavor and texture. In contrast, the food product produced by the method of Barlow consists of a flavored coating surrounding the meat of a dried fruit product, with the dried fruit product retaining its natural flavor characteristics. In addition, the Barlow product is sticky to the touch. Moreover, product by process claims enable an Applicant to claim an otherwise patentable product that resists definition by other than the process by which it is made, In re Thorpe, 227 U.S.P.Q. 964 (Fed. Cir. 1985). Applicants submit that such is the case with the product of claim 6. Reconsideration and withdrawal of the Examiner's rejection is respectfully requested.

It is believed that the above represents a complete response to the Examiner's rejection under 35 U.S.C. 103, and places the present application in condition for allowance. Reconsideration and early allowance are requested.

To the extent necessary, a petition for an extension of time under 37 C.F.R. 1.136 is hereby made. Please charge any shortage in fees due in connection with the filing of this paper, including extension of time fees, to Deposit Account 18-1810 and please credit any excess fees to such deposit account.

Respectfully submitted,

LOWE, PRICE, LEBLANC & BECKER



Holly D. Kozlowski
Registration No. 30,468

99 Canal Center Plaza, Suite 300
Alexandria, Virginia 22314
(703) 684-1111

April 30, 1991

EXHIBIT 5

United States Patent [19]

Agarwala

[11] **Patent Number: 4,542,033**

[45] **Date of Patent: Sep. 17, 1985**

[54] **SUGAR AND ACID INFUSED FRUIT PRODUCTS AND PROCESS THEREFOR**

[76] Inventor: **Om P. Agarwala,** 536 - 17th Ave. NW., New Brighton, Minn. 55112

[21] Appl. No.: **663,744**

[22] Filed: **Oct. 23, 1984**

Related U.S. Application Data

[63] Continuation-in-part of Ser. No. 469,189, Feb. 24, 1983, abandoned.

[51] **Int. Cl.**[4] **A23B 7/10;** A23B 7/03; A23B 7/02; A23L 3/34

[52] **U.S. Cl.** **426/321;** 426/577; 426/615; 426/620; 426/639; 426/640

[58] **Field of Search** 426/102, 103, 615, 620, 426/639, 640, 321, 577, 442, 464, 100

[56] **References Cited**

U.S. PATENT DOCUMENTS

2,651,575	9/1953	Talburt et al. .
3,365,309	1/1968	Pader et al. .
3,453,118	7/1969	Jobin .
3,800,049	3/1974	Larroche et al. .
3,833,747	9/1974	Cording et al. .
3,892,870	7/1975	Wood .
3,952,112	4/1976	Fulger et al. .
4,055,675	10/1977	Popper et al. .
4,103,035	7/1978	Fulger et al. .
4,256,772	3/1981	Shanbhag et al. .
4,355,050	10/1982	Butland .
4,361,589	11/1982	Wauters et al. .
4,390,550	6/1983	Kahn et al. .

Primary Examiner—Raymond N. Jones
Assistant Examiner—Elizabeth C. Weimar

[57] **ABSTRACT**

Disclosed are processes for preparing shelf stable fruit pieces. The process comprises the steps of (a) providing fresh fruit pieces; (b) deactivating or retarding enzymatic browning; (c) cooking in an acidified sugars syrup; optionally (d) cooling and draining; (e) sulfiting; and (f) dehydrating. The fruit pieces so prepared are soft in texture, even when dried to low A_w's, and can be used in R-T-E cereals or as snack items per se.

21 Claims, No Drawings

SUGAR AND ACID INFUSED FRUIT PRODUCTS AND PROCESS THEREFOR

CROSS-REFERENCE TO RELATED APPLICATION

This application is a continuation-in-part application of U.S. Ser. No. 469,189 filed Feb. 24, 1983, now abandoned.

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to food products and to their methods of preparation. More particularly, the invention is directed to fruit products, particularly dehydrated, to cereal products containing such fruit products, particularly R-T-E dry breakfast cereals, and to the methods of preparing such products.

2. The Prior Art

Fruit and fruit products enjoy widespread consumer appeal due in part to the wholesomeness and organoleptic attributes of fruit. However, due to the limited shelf life of fruits, efforts from time immemorial have been made to extend the storage of fruits, including, for example, canning, freezing and drying.

Drying long has been the most common technique to prepare fruit products which do not require special packages or storage conditions. Dehydrated fruit products such as apples, raisins, prunes, and the like are popular snack items. Also, the combination of fruit and dry, ready-to-eat ("R-T-E") cereal has significant consumer appeal. Although enjoying some consumer acceptance, food products, particularly R-T-E cereals, containing dried fruit products face problems inherent in combining diverse, dried food materials.

For example, for a stable, crisp, R-T-E cereal, the moisture content is reduced so that the water activity ("A_w") ranges between 0.2 to 0.4 typically to levels of 1–4%. Fruit conventionally dehydrated to comparable water activity levels are usually hard and/or very tough in texture and fibrous in structure and thus unsuitable for combining with the cereals. Moreover, the flavor progressively deteriorates with greater drying. If, however, fruit pieces are only dried to higher A_w's so as to retain desirable texture and flavor eating qualities, then they will either not be bacteriologically stable at room temperatures, or when admixed with the dry cereal, will tend over time to lose moisture to the relatively drier cereal and thus cause the cereal to become less crisp or soggy and the fruit to become again hard, dry and excessively tough.

A wide variety of methods are used or have been suggested for use to provide shelf stable fruit or fruit products suitable for incorporation into R-T-E cereal products. Generally, one or more of three basic approaches have been taken. One basic approach has been made to attempt to modify the texture of low water activity fruits. For example, in U.S. Pat. No. 3,453,118 (issued July 1, 1969 to Jobin) low moisture raisins are treated with either acidic or basic baths for brief periods to maintain softness. Post dehydration treatment tends, however, to result in loss of product identity.

A second basic approach has been to dry fruits only partially to maintain good flavor and texture while treating the fruit pieces to enhance either bacterial stability and/or to bind the higher moisture content so as to lower water activity by infusion of sugars and/or humectants, e.g., polyol. For example, U.S. Pat. No. 4,256,772 (issued Mar. 17, 1981 to Shanbhag and Szczesniak) wherein fruits are infused with polyols and sucrose. U.S. Pat. No. 3,952,112 (issued Apr. 20, 1976 to Fulger) discloses processing to increase humectant absorbtion. For certain fruits, i.e., grapes, having an intact skin, an acid treatment step prior to infusion to open the skin to infusion has been taught (see U.S. Pat. No. 4,103,035, issued July 25, 1978 to Fulger et al.).

A third basic approach is to radically restructure the dried fruit piece to improve texture. U.S. Pat. No. 4,055,675 (issued Oct. 25, 1977 to Popper et al.) discloses processes for preparing puffed raisins. U.S. Pat. No. 3,833,747 (issued Sept. 3, 1974 to Cording and Eskew) also discloses processes for preparing puffed dried fruit. U.S. Pat. No. 3,315,619 (issued Apr. 25, 1967 to Slaybaugh) discloses a simulated fruit product comprising fruit puree and structured with starch and gums.

All of these approaches of the prior art attempt to overcome one or more of the deficiencies in stability, texture, flavor and/or color in dried fruits and claim improvements in one or more of these properties. The sheer variety and number of approaches taken each suggest the difficulty in preparing shelf stable dried fruit product having an overall improvement in these properties. Notwithstanding the claimed benefits of the prior art attempts, there is a continuing need for new and useful processes for the preparation of high quality dried fruit.

The present invention thus surprisingly provides improved dried fruit products, an improved process for preparing shelf stable fruit, and R-T-E cereals containing such fruit. The present process provides fruit pieces of soft texture at low A_w with improved natural flavor but without having objectionable off-flavors due to addition of humectants. The present fruit piece products surprisingly are readily recognizable from both visible and flavor standpoints as shelf stable pieces of the fruits from which they are derived and thus do not exhibit loss of product identity. Moreover, the texture improvement advantages are realized without requiring radical restructuring of the dried fruit piece. Indeed the most dramatic improvements in product attributes provided by the present fruit products compared to prior art is in texture or "bite." In certain preferred embodiments, shelf stable fruit pieces are provided without any additives and thus are stylized as being "all-natural."

SUMMARY OF THE INVENTION

The present invention relates to processes for providing shelf stable fruit pieces having improved flavor and texture and which are particularly suitable for incorporation into R-T-E cereals. The process comprises a first step of (a) providing pieces of fresh fruit; (b) deactivating or retarding the enzymatic browning in case of fruits with active polyphendoxidase (ppo) enzymes; (c) cooking the fruit pieces in a sugar(s) syrup at a pH of about 3.75 to 1.5. The syrup desirably has a solids concentration of from about 30% to about 90%. Optionally, the syrup can comprise about 0.1% to 30% of a polyhydric alcohol. The cooking step is practiced at a temperature of from about 140° F. to 200° F. (60° C. to 93° C.) for about 10 to 60 minutes. Thereafter, in certain embodiments of the present invention, the fruit pieces are drained and allowed to cool. The cooled pieces can then be dried to desired moisture contents or A_w.

In its product aspect, the present invention relates to intermediate acid hydrolyzed sugar infused fruit pieces

and also to the shelf stable fruit pieces realized by the present processes. Also, the present invention relates to R-T-E cereals comprising from about 1% to about 50% of the shelf stable fruit pieces and conventional cereal pieces.

DETAILED DESCRIPTION OF THE INVENTION

The present invention relates to shelf stable fruit pieces, to methods for the preparation of such shelf stable fruit pieces, and to R-T-E cereals containing such fruit pieces. Each of the method steps as well as product use are described in detail below.

Throughout the specification and claims percentages are by weight and temperatures in degrees Fahrenheit unless otherwise specified.

A. Providing Fruit Pieces

The present invention is especially suitable for use in connection with all types of fresh fruit. Although useful herein, previously frozen fruits or canned fruit are less desirable. Preferred for use herein are those fruits which are high in pectin content. Although useful, less preferred for use herein are those fruits having high levels of fruit juices such as tomatoes or strawberries and citrus fruits. Exemplary preferred fruits for use herein include apples, pears, cherries, apricots, pineapple, peaches, plums, and the like. Both peeled and unpeeled fruit pieces are useful. The fruit pieces can be in any shape or form such as slices or diced or otherwise shaped. Preferred for use are diced fruit, e.g., apx. 1–3 cm. weighing 0.5 to 10 g., although both larger or smaller pieces can also be used. Of course, mixtures of fruit can also be prepared together herein if desired.

B. Enzyme Inactivation

After the fruit has been formed into pieces, it is important to inactivate or at least substantially retard the fruit's enzymes to prevent browning if the fruit pieces are not immediately subjected to the present cooking step for those fruits having active ppo enzymes. Of course, when canned fruits are used as the fruit source, the enzymes have been previously inactivated by the previous canning operation. Even through the enzymes are inactivated at the end of the subsequent cooking period at low temperature cooking, the first few minutes after slicing, dicing, etc. can cause browning in fruits with active ppo. Conventional techniques such as blanching, sulfiting, or cooking in ascorbic acid bath are useful for this step. Of course, combinations of these techniques can be used. Blanching is preferred for use herein in realizing finished fruit products since the products are characterized by the absence of additive materials and are thus referred to as "all-natural". Blanching can be practiced by immersing the fruit pieces in a boiling water bath for about 30 seconds to 5 minutes.

Sulfur dioxide as well as sulfurous acid salts or other treating agents supplying a SO_2 moiety are commonly added to foods for preservation purposes including dried fruit. This process is known by several terms including sulfuring or sulfurization, sulfitization or, most commonly, sulfiting. If sulfiting is to be used for enzyme inactivation, then the fruit pieces can be immersed into a water bath containing conventional sulfiting agents (e.g., sodium bisulfite, sulfur dioxide, sodium sulfite, sodium metabisulfite, potassium bisulfite, potassium metabisulfite, and mixtures thereof) for a time sufficient to provide a sulfite content of from about 30 to 3,000 parts per million. Typical water bath sulfite concentrations range from about 0.1% to 2% while immersion times typically range from about 10 seconds to 10 minutes. Bath temperature is not critical and typical temperatures range from about 60° F. to 185° F. (15° C. to 85° C.).

Enzymatic browning can be retarded by dipping fruits at room temperature in a bath containing 0.1% ascorbic acid and/or 0.1% to 2% citric acid. Ascorbic acid can also be combined with sulfur dioxide with an advantage to reduce levels of sulfur dioxide conventionally required in the final product. It is known that ascorbic acid inhibits browning by sequestering oxygen present in and around the fruit tissue.

C. Cooking

Another important step in the present process is to cook the fruit pieces in sugar(s) syrups of controlled pH and temperature for controlled times. While not wishing to be bound by the proposed theory, it is speculated herein that the present process results in selectively breaking down the insoluble protopectins to soluble pectins. Concurrently, the semipermeability of the cell membranes is lost and a large amount of soluble sugars and acid is infused into the individual cells. During cooling the soluble pectin-sugar-acid-water form a three dimensional gel network in the inter- and intracellular spaces. The formation of such gels prevent collapse of the fruit cell structure upon subsequent dehydration and the concommitant development of a tough, leathery texture characteristic of the inferior product of the prior art, and are responsible for the firm and yet clean "bite" of the present products.

Sugar(s) selection is not critical and the sugar(s) syrup can be prepared using any conventional nutritive carbohydrate sweetening agent including both mono- and disaccharides such as sucrose, invert sugar, dextrose, corn syrup including high fructose corn syrup, maltose, honey, fructose, corn syrup solids and fruit juices. Preferred sugars are selected from the group consisting of sucrose, corn syrup, fructose, fruit juice and mixtures thereof. Where cost is a primary consideration, sucrose is the sugar of choice. If flavor quality is of paramount concern, then fruit juices or juice powders are the sugar of choice. The solids concentration should be at least about 30%. Upper operable concentrations are limited only by handling considerations. Generally, however, upper practical concentrations will be about 90%. For better results in terms of final product attributes, the solids content desirably ranges from about 50% to 70%. For best results, about 60% is preferred. The syrup can be supplied in whole or in part from single or multiple strength fruit juices of one or more types or even juice powders whether the same or different from the fruits being treated.

It is most important to control the pH of the mixture of fruit pieces and syrup. The pH of fresh fruits typically ranges from about 4.0 to 4.5. The pH of the syrup, however, should be less than about 3.8. The pH can be as low as about 1.5. Preferably, the pH ranges from about 2 to 3.6. For best results the pH is about 3.2. The pH can be adjusted by adding sufficient amounts of any food grade acidulant including both edible organic acids and mineral acids as well as fruit juices, and mixtures thereof. Suitable edible organic acids include, for example, citric, malic, adipic, fumeric, and mixtures thereof. Exemplary mineral acids include phosphoric, hydrochloric and sulfuric acids. Exemplary acidifying fruit juices include, lemon juice, lime juice, vinegar, apple cider, and mixtures thereof.

Optionally, the cooking syrup may contain adjuvants which are desired to be infused into the fruit pieces. Such adjuvants may include, for example, minor amounts (0.1 to 2%) flavors, and colors. The syrup may also contain greater amounts of a variety of edible polyhydric alcohols. These same materials are also sometimes referred to in the art as "hydrogenated glucose syrups." The infusion of polyols for texture control, moisture simulation and water activity reduction is well known. (Generally, see for example, U.S. Pat. No. 3,769,042, issued Oct. 30, 1973 to Kaplow et al. and for infusion of fruits, U.S. Pat. No. 4,256,772, issued Mar. 17, 1981 to Shambhag et al., each of which is included herein by reference.) Exemplary suitable polyols include sorbitol, mannitol, glycerol, propylene glycol and mixtures thereof. Glycerol is the preferred polyol. If present, the polyol can comprise about 0.1 to 30%, preferably 15 to 25% of the syrup. Surprisingly, the polyhydric alcohols can be simultaneously infused with the sugars without adversely affecting the effects of the pH or the sugars.

The temperature of the syrup ranges from about 120° F. (49° C.) to 200° F. (93° C.). Preferably, the temperature ranges from about 140° F. (60° C.) to 185° F. (85° C.). For best results the temperature is about 165° F. (74° C.). The time which the fruit pieces is treated is dependent upon the several interdependent variables such as temperature, the pH, and the desired end product attributes. Shorter times are used with higher temperatures, lower pH, and when more firm textures are desired and when less sugar(s) infusion is desired.

During the cooking step, in addition to in situ acid hydrolysis of insoluble pectins, the sugars from the sugar, syrup infuse the cells of the fruits. While the weight ratio of syrup to fruit pieces is not critical, the syrup must contain initially, or supplemented during cooking, to supply sufficient sugar(s) solids to infuse the fruit pieces. Fruits typically contain about 85% moisture and 15% total solids. After the cooking step, the solids content is raised to about 40–60% due to some water loss and the sugar(s) infusion.

Optionally, the texture can be modified by manipulating the calcium ion-soluble pectin interaction. Should more firm textures be desired, additional calcium than naturally present can be introduced by simply adding small amounts of calcium salts sufficient to provide a calcium ion concentration of from about 100 to 1,000 ppm in the fruit pieces, e.g., calcium chloride, phosphate and/or oxide. Conversely, should a less firm texture be desired in the finished product, the naturally present calcium can be chelated by introducing such chelating agents as sodium oxylate, citric acid or ethylene diamine tetra acetic acid, e.g., of from about 100 to 1,000 ppm in the fruit pieces.

D. Cooling to Below the Gelling Point

The infused fruit pieces are removed from the sugar syrup and allowed to drain and cool. It is desirable to cool the fruit pieces to below the gelling point of the pectin gel formed within and between the cells of the fruit to set the gel. The gelling point is influenced by several factors including the concentration of sugars, pH, water-soluble pectin content and the esterification of pectins.

In general, however, the gelling points of the fruit products prepared by the present invention range from about 110° F. to 150° F. (43° C. to 65° C.). Accordingly, the fruit pieces can be conveniently cooled to below the gelling point in all cases by coming to room temperature (65° F., 18° C.). If desired, cooling can be accelerated by any conventional means, e.g., immersion into cold water baths or forced cool air convection cooling. While less desirable, the fruit pieces can be cooled without first removing from the syrup and draining by simply cooling both the syrup and fruit pieces. Also, if desired, the cooling step can be combined with the subsequently described dehydration step such as by cooling with forced air drying at an air temperature below the gelling temperature.

E. Sulfiting

An optional step (but desirable in preferred embodiments of the present process) after cooling the fruit pieces is to treat with a sulfiting agent to inhibit non-enzymatic browning. Enzymatic browning is effectively inhibited by the cooking step even if an enzymatic inhibition step had not been previously employed. Post cooling sulfiting is a preferred step even when a precooking sulfiting step is practiced due to the sulfite loss resulting from the cooking step. Conventional materials and concentrations are used and processing can be used for the enzyme inactivation as described above.

If an "all-natural" product is desired, the post cooking sulfiting step can be eliminated and non-enzymatic browning can be inhibited by increasing the sugars content combined with ascorbic acid and dehydrating to lower moisture contents and/or by distributing at refrigerated/freezer temperatures.

The intermediate fruit pieces prepared by these steps can be used in a variety of applications. For those embodiments which have been infused with sugars of up to about 60–65% combined with low pH are shelf stable and require no further processing. Other embodiments having less than about 60% sugars require either refrigerated or frozen storage. However, these intermediate products do not hard freeze at these temperatures since the moisture is sufficiently bound to prevent crystallization. Thus, these intermediate fruit products are especially useful as ingredients for frozen or refrigerated foods such as ice creams, sherbets, yogurts and cottage cheese.

F. Drying

The sulfited infused fruit pieces are then desirably dehydrated by any conventional dehydration technique to realize the present dried fruit products. Forced hot air conventional drying is preferred. Such drying is preferably conducted at air temperatures ranging from about 110° F. to 150° F. (43° C. to 65.5° C.) to minimize heat damage and to preserve the fresh fruit color and flavor.

The drying is continued until the desired water activity is obtained. Desired water activity will depend upon a variety of factors such as desired product texture properties and product use or application. Generally, the fruit products are dried to A_w's ranging from about 0.35 to 0.9 and preferably from about 0.5 to 0.7.

It is an advantage of the present invention that drying times are substantially reduced compared to untreated fruits. Drying time reductions of about one half and even up to 90% are obtained by the present invention. Such reductions result from the higher solids content due to sugar(s) infusion of the treated fruit pieces to be dried compared to fresh fruits. Reduced drying requirements provide energy, and drying equipment capitalization costs reductions. Additionally, both flavor and color degradation are reduced due to reductions in drying times since flavor and color constituents are less subject to being driven off or to thermal degradation.

The fruit pieces prepared by the present invention can be used in various ways. For example, the dried fruit pieces can be consumed by themselves as a snack item or in combination with other items, e.g., granola, nuts, etc. The fruit pieces can be added to both dry or instant dry cereals, e.g., oatmeal, which are dry packaged. Preferred embodiments of the dried fruit pieces find particular usefulness as a component of dried, R-T-E cereals and are characterized by an A_w of about 0.5 to 0.6 and a sugar solids concentration prior to final dehydration of about 40% to 60%. If a polyol has been infused into the fruit pieces, the pieces at comparable A_w's will have even lower moisture contents due to displacement of same water by the polyol. With polyol contents of 0.1% to 30% of the fruit pieces, the moisture content can range from about 10% to 15%. In other applications, e.g., baking, if desired, the infused dried fruit pieces can be rehydrated prior to use.

The present dried, infused fruit products have a remarkable extended storage stability while maintaining their desirable texture, color and appearance as compared to non-infused dried fruit products. Still another advantage of the present fruit pieces is that they remain soft even at freezer temperatures.

The R-T-E cereals which the present dried fruit products can be combined include all R-T-E cereal particles in flaked, shredded, expanded, or other forms, such as wheat flakes, corn flakes, shredded wheat, puffed wheat, rice, oat, or corn, bran flakes, whole bran cereal, breakfast cereals in the form of extruded and puffed doughs, and the like. Such cereal particles are prepared in conventional manner and may be either toasted or untoasted.

The following examples are included for illustrative purposes only and are not intended to limit the scope of the invention.

EXAMPLE I

Ten fresh firm ripe D'Anjou pears (2,000 g.) were cored and peeled on a bench-top peeler. The fruits were diced into $\frac{1}{4}''$ cubes and immediately soaked in 1.5 wt. percent sodium sulfite solution for 2–5 minutes. 5000 g. of high fructose corn syrup (72° Brix) were adjusted to pH 2.8 with lemon juice. The syrup was then heated to 165° F. in a temperature controlled bath. The pear dices taken out of the sulfite bath, drained for 10–20 seconds, and were kept submerged in the syrup bath for 45 minutes. The fruit pieces were then taken out of the syrup and dipped in another 1% sodium bisulfite bath having a temperature of 70° F. for 30 seconds to accomplish both the cooling and sulfiting steps. The pear pieces were then dried in a cabinet dryer for 3 hours at 135° F. The final A_w was 0.6.

The dried pieces were blended with Wheaties® brand toasted wheat flakes, A_w=0.4, and stored at 100° F./25% R.H. (relative humidity) for accelerated shelf life storage test. For comparison, 60 g. of toasted wheat flakes were mixed with 15 g. of conventionally prepared dried fruit in foil of comparable A_w triplex material pouches. The fruits retained a soft and chewy texture even after eight weeks of storage. In contrast, the commercially available dry pears were unacceptably hard and tough under identical storage conditions.

EXAMPLE II

Ten pounds (4.53 kg.) of firm ripe apples were sliced through a commercial slicer without peeling. Cores were removed. The slices were immediately dipped in a boiling sugar solution (with 15% soluble solids) for 10 seconds to retard non-enzymatic browning. Commercially available apple juice concentrate was diluted with distilled water from 72° Brix to 58° Brix and the pH adjusted to 3.2 with 2% citric acid solution. 25 lbs. (11.33 kg.) of the juice was heated in a Hotpoint Fryer and maintained at 165° F. The apple slices contained in a screen basket were then kept submerged in the juice concentrate for 30 minutes. During acid hydrolysis the solid content of the apple slices increased from 15.3% to 38.3%. The slices were then dried at 135° F. (57.2° C.) for 1.5 hours until they reached a water activity of 0.7.

The product had a very soft and crisp (fresh fruit-like) texture with strong apple flavor. The product so prepared is useful distributed, refrigerated or frozen (to retard non-enzymatic browning) for uses as all-natural snack, and also as salad topping, dessert, etc. and can be distributed at room temperature, refrigerated, or even frozen.

The dried apple slices were evaluated using a single blade Kramer Shear Cell attached to an Instron TM brand universal testing machine (Instron Corp., Canton, MA, Model No. 1122). As shown in the table below, conventionally dried commercially available apple slices of the same A_w showed higher resistance to shear, i.e., were tougher pieces.

TABLE

Product	Shear Force in Kgs. Avg. of 10 Replicates
Commercial slices	6.7
Present - fruit pieces	
30 min. cook time	5.5
40 min. cook time	5.1
50 min. cook time	4.6

EXAMPLE III

Firm ripe whole peaches were peeled by dipping in boiling water and hand rubbing to remove the peels. The peaches were sliced and immediately dipped in a 2% ascorbic acid solution. 500 g. of sucrose was dissolved in 500 ml. of distilled water and the pH adjusted to 2.6 with a combination of sodium citrate and citric acid. 300 g. of peach slices were then kept submerged in the sugar syrup for 30 minutes and the temperature was maintained at 165° F. The fruit pieces were then drained and sulfited for 30 seconds in a 1% sodium bisulfite solution. Drying was accomplished by drying for 3 hours at 135° F. The final A_w=0.63.

The product maintained acceptable texture for eight weeks when stored with Wheaties® brand toasted wheat flakes R-T-E cereal in a foil triplex pouch.

EXAMPLE IV

A whole pineapple was prepared manually to yield dices from the edible portion. Ionex TM brand pineapple juice concentrate (70° Brix) bath was adjusted to pH 3.2 with a 2% adipic acid solution and heated to 185° F. The pineapple dices were then dipped and kept submerged for 10 minutes. The pineapple pieces were drained and cooled for 30 minutes at room temperature. The pieces were then divided in two batches. One batch was dried to an A_w of 0.5 for compatibility with R-T-E cereals. The second was dried to an A_w of 0.8 to be used as snacks. The dried fruit pieces of the present invention were very soft and slightly chewy at both A_w's.

EXAMPLE V

Firm ripe apricots were peeled by dipping into a 1½% boiling lye solution for 60 seconds followed by thorough washing. The fruits were then sliced and sulfited as in Example IV.

Sixty three D.E. corn syrup was used for the cooking medium, and a 2% citric acid was used to adjust pH to 3.0. The 1,000 g. of apricot slices were cooked in 2,500 g. of the syrup for 45 minutes and the temperature of the mixture was maintained at 160° F. throughout. The sugar infused and cooked fruit slices were then drained, dipped in a 1% sodium sulfite room temperature bath and dried to A_w of 0.6 in a conventional manner. The fruits were judged by a panel as very soft with fresh apricot flavor retained.

EXAMPLE VI

Ten, firm ripe apples were peeled using a hand peeler and cut into halves. To prevent browning, the fruit halves were immediately soaked in 1.5 wt. percent sodium sulfite solution for 2–5 minutes. 1000 gm of Lycasin 80/55 (product of Roguette Corp.), an hydrogenated glucose syrup, were mixed with 4000 gm of high fructose corn syrup (72° Brix) and were adjusted to pH 2.8 with lemon juice. The syrup was then heated to 165° F. in a temperature controlled bath. The apple halves were taken out of the sulfite bath, drained for 10 to 20 seconds and heated in the prepared syrup mix for 45 minutes. The fruit halves were taken out of the syrup and dipped in another 1% sodium sulfite bath having a temperature of 70° F. for 30 seconds to accomplish both the cooling and sulfiting steps. The apple halves were then dried in a tray drier for 10 hours at 155° F. The final A_w was 0.45. The halves were then reduced to flakes or pieces by processing through a grinder.

80 g. of the apple flakes were blended with 400 g. Wheaties ® brand toasted wheat flakes having an initial A_w of 0.4 and the apple flakes maintained their softness even after 12 weeks of storage at 100° F./25% relative humidity.

What is claimed is:

1. A method for preparing shelf stable fruit pieces exhibiting improved flavor, color and texture, comprising the steps in sequence of:

(A) providing fruit pieces;

(B) cooking the fruit pieces in a syrup, said syrup consisting essentially of

(1) sugar or sugars at a concentration of about 30% to 90% by weight of the syrup,

(2) sufficient acidulants to provide the syrup with a pH of about 3.75 to 1.5, and the syrup having

(3) a temperature of about 120° F. to 200° F. for about 10 to 60 minutes to form cooked, fruit pieces wherein sugar and acid are infused into the individual cells of the fruit pieces;

(C) removing the fruit pieces from the syrup; and

(D) cooling the infused fruit pieces to below their gelling point to form a gel within and between the cells of the fruit.

2. The method of claim **1** wherein the pieces of fruit are prepared from fresh fruit and wherein the fruit is selected from the group consisting of apples, pears, cherries, apricots, pineapple, peaches, plums, and mixtures thereof.

3. The method of claim **2** further comprising the step of

(E) dehydrating the fruit pieces.

4. The method of claim **3** wherein the fruit pieces are dehydrated to an A_w of about 0.35 to 0.9.

5. The method of claim **4** wherein the sugar component of the syrup comprises fruit juice or juice powders.

6. The method of claim **5** wherein the syrup comprises an acidifying fruit juice selected from the group consisting of lemon juice, lime juice, vinegar, apple cider, and mixtures thereof.

7. The method of claim **6** further comprising the step, immediately after step A of inactivating browning enzymes of the fruit pieces.

8. The method of claim **4** wherein the pH is about 2 to 3.6 and wherein the fruit pieces are dried to an A_w of 0.5 to 0.7.

9. The product produced by the method of claim **1**.

10. The product produced by the method of claim **8**, and wherein the sugar solids range from about 40% to 60% by weight of the fruit piece.

11. The product produced by the method of claim **10** wherein the cereal is a ready-to-eat breakfast cereal.

12. The product of claim **11** further comprising from about 99% to 50% of dry ready-to-eat breakfast cereal.

13. The method of claim **4** wherein the sugar syrup additionally comprises from about 0.1% to 30% by weight of an edible polyhydric alcohol or sugar alcohol.

14. The method of claim **13** wherein the sugar syrup comprises from about 15% to 25% by weight of an edible polyhydric alcohol selected from the group consisting of mannitol, sorbitol, glycerol, propylene glycol and mixtures thereof.

15. The method of claim **14** wherein the edible polyhydric alcohol is glycerol.

16. The product produced by the method of claim **13**.

17. The product produced by the method of claim **14**.

18. The product produced by the method of claim **15**.

19. The product produced by the method of claim **4**.

20. The product produced by the method of claim **5**.

21. The product produced by the method of claim **6**.

* * * * *

EXHIBIT 6

US005320861A

United States Patent [19]

Mantius et al.

[11] Patent Number: 5,320,861

[45] Date of Patent: Jun. 14, 1994

[54] **FRUIT EXTRACTION AND INFUSION**

[75] Inventors: **Harold L. Mantius**, Raynham; **Peter R. Peterson**, Taunton, both of Mass.

[73] Assignee: **Ocean Spray Cranberries, Inc.**, Lakeville-Middleboro, Mass.

[21] Appl. No.: **816,803**

[22] Filed: **Jan. 3, 1992**

[51] **Int. Cl.**[5] **A23L 2/04**; A23L 3/40

[52] **U.S. Cl.** **426/599**; 426/640; 426/655; 99/495

[58] **Field of Search** 426/639, 655, 640, 599

[56] **References Cited**

U.S. PATENT DOCUMENTS

19,421	2/1858	Helton .	
1,704,367	3/1929	Moore .	
1,763,121	6/1930	Bailey .	
1,858,796	5/1932	Wilcoxson .	
2,080,542	5/1937	Kuss et al. .	
2,139,585	12/1938	Hunter	134/60
2,491,115	12/1949	Kincaide .	
2,509,543	5/1950	Truax et al.	259/6
2,554,769	5/1951	Arnold	259/109
2,571,300	10/1951	Simpson .	
2,626,856	1/1953	Alles	23/284
2,692,831	10/1954	Weckel et al. .	
2,746,730	5/1956	Swenson et al.	259/9
2,785,071	3/1957	Matthews	99/102
2,847,282	8/1958	Dunning et al. .	
2,865,758	12/1958	Weckel	99/102
3,057,736	2/1960	Forkner	99/204
3,142,574	7/1964	Anderson	99/102
3,723,487	3/1973	Couche	260/412.4
3,800,055	3/1974	Gallagher	426/432
4,048,343	9/1977	Levine .	
4,205,919	6/1980	Attwell	366/34
4,225,628	9/1980	Lynn .	
4,326,926	4/1982	Gerow .	
4,363,264	12/1982	Lang et al. .	
4,390,550	6/1983	Kahn et al.	426/102
4,497,838	2/1985	Bonnell	426/429
4,551,348	11/1985	O'Mahoney et al.	426/639
4,647,466	3/1987	Japikse et al.	426/639
4,693,905	9/1987	Japikse et al.	426/387
4,775,545	10/1988	Augustine et al.	426/639
4,789,558	12/1988	Winkler et al. .	
4,814,190	3/1989	Ismail	426/102
4,818,555	4/1989	Piotrowski et al.	426/599
4,873,095	10/1989	Rundle	426/50
4,889,739	12/1989	Powers et al.	426/599
4,902,518	2/1990	Lang et al.	426/14
4,938,985	7/1990	Swaine, Jr. et al.	426/599

FOREIGN PATENT DOCUMENTS

69835/87	3/1987	Australia .
878427	8/1971	Canada .
0130660	1/1985	European Pat. Off. .
1179183	10/1964	Fed. Rep. of Germany .
2459407	11/1976	Fed. Rep. of Germany .
8604126	2/1986	Fed. Rep. of Germany .
400678/A1	9/1991	Fed. Rep. of Germany .
WO87/05255	9/1987	PCT Int'l Appl. .
WO90/05463	5/1990	PCT Int'l Appl. .

OTHER PUBLICATIONS

Commercial Fruit Processing, Edition 2, Edited by Woodruff, J. G.; Bor Shiun Luh, USA, 1986, pp. 191–198, 321, 433–436.

Shukla, "Osmotic Dehydration", Cereal Foods World, p. 687.

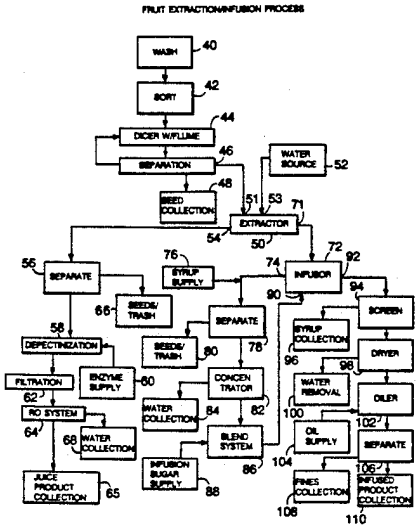
Primary Examiner—Carolyn Paden

Attorney, Agent, or Firm—Fish & Richardson

[57] **ABSTRACT**

Extraction, especially of firm fruit such as cranberries, with improved yields of high quality, low tannin juices by using an improved countercurrent extractor employing longitudinal members positioned between adjacent flights and reinfusion of decharacterized, extracted fruit pieces with infusion syrups, such as juices from fruits other than that extracted, to produce a fruit food product of various flavors having a desired level of inherent soluble fruit component, without the need to bleed off spent syrup as a byproduct.

41 Claims, 3 Drawing Sheets



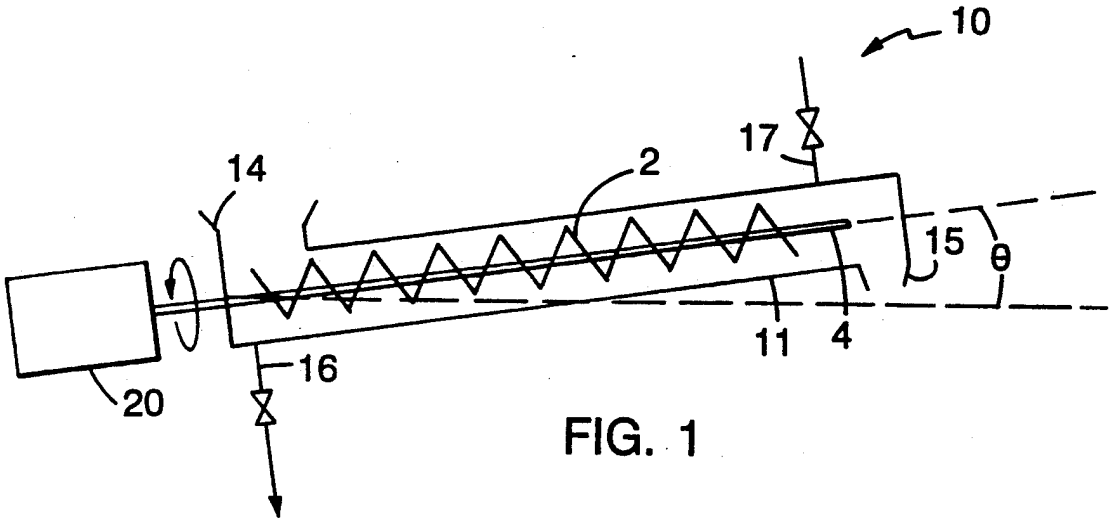


FIG. 1

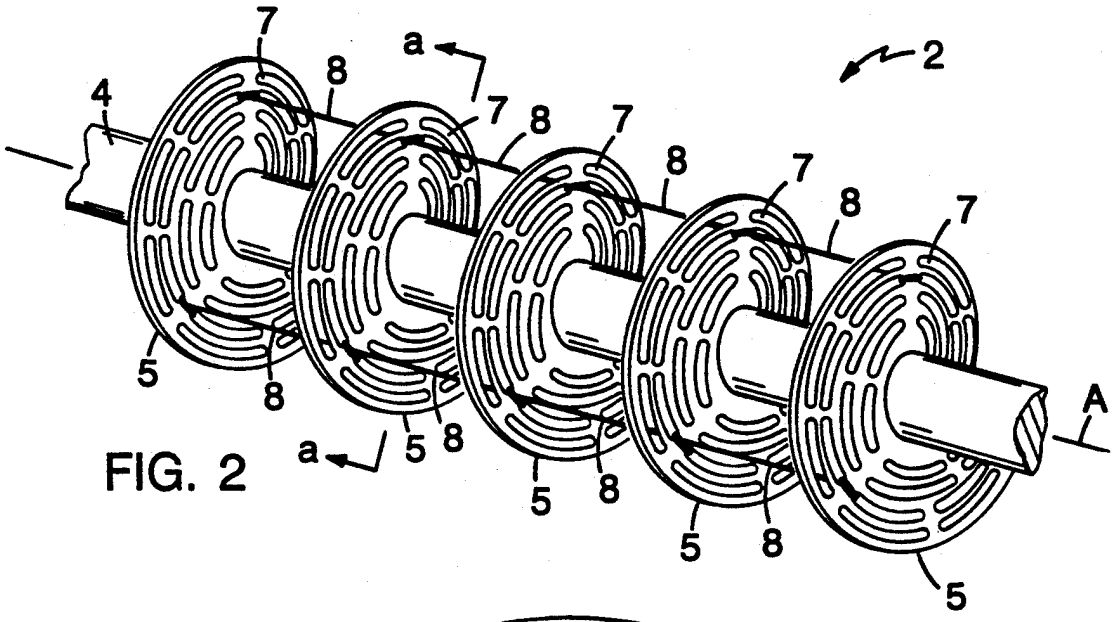


FIG. 2

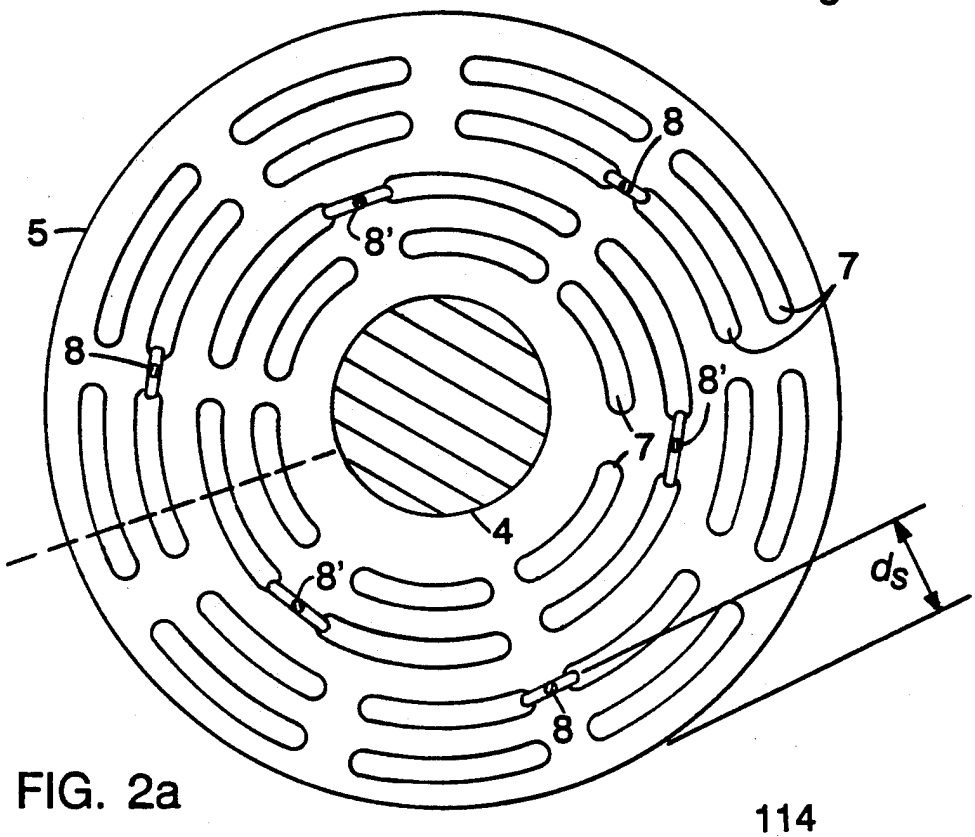


FIG. 2a

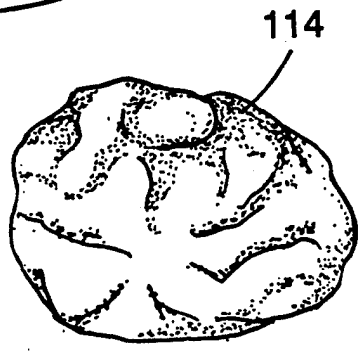


FIG. 4

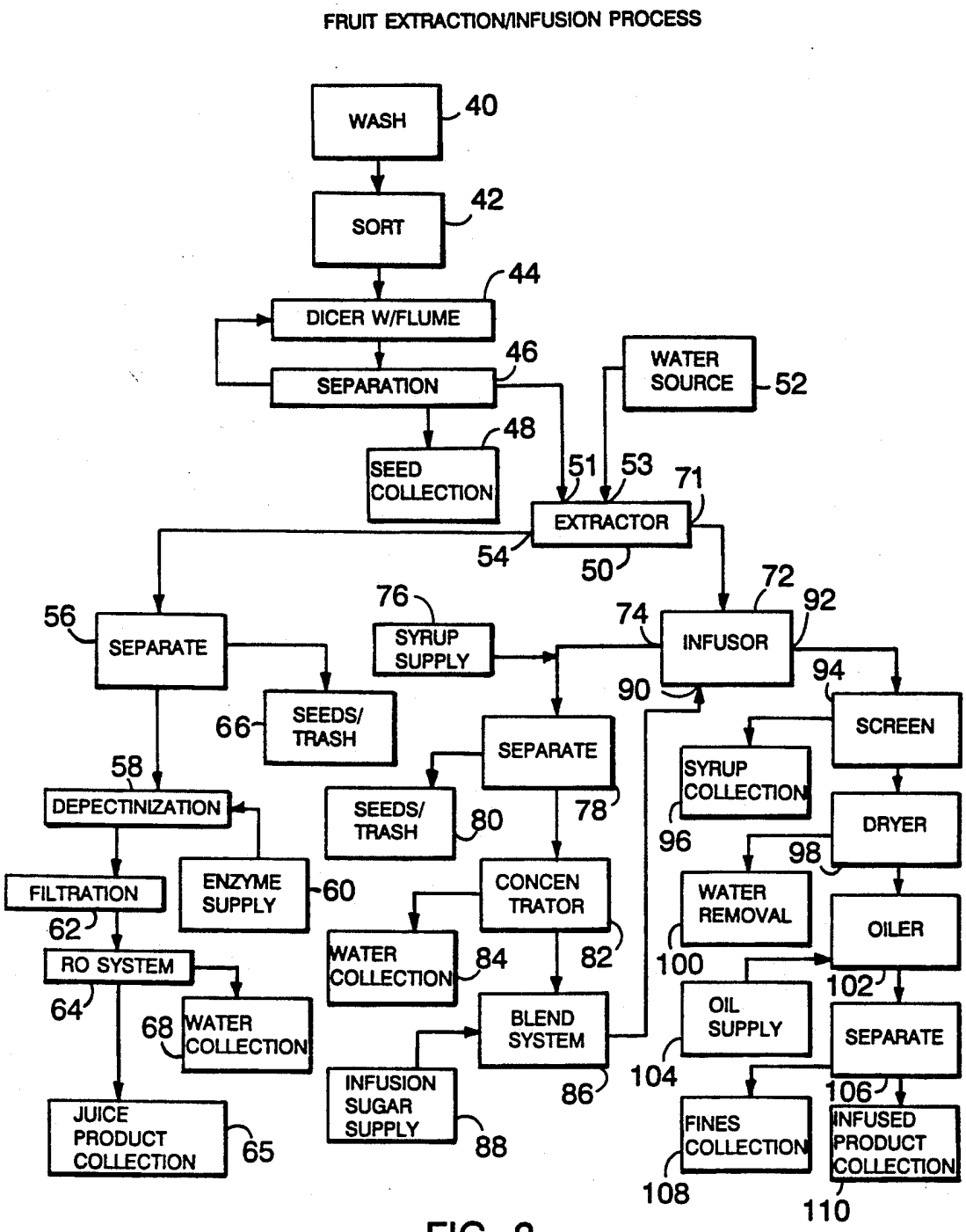

FRUIT EXTRACTION/INFUSION PROCESS
WASH
40
SORT
42
DICER W/FLUME
44
SEPARATION
46
WATER SOURCE
52
SEED COLLECTION
48
51
53
71
EXTRACTOR
54
50
72
92
56
SEPARATE
76
SYRUP SUPPLY
74
INFUSOR
94
90
SCREEN
66
SEEDS/ TRASH
SEPARATE
SYRUP COLLECTION
58
DEPECTINIZATION
SEEDS/ TRASH
80
78
DRYER
96
98
FILTRATION
ENZYME SUPPLY
60
CONCEN TRATOR
WATER REMOVAL
OILER
62
100
RO SYSTEM
WATER COLLECTION
84
82
102
64
68
WATER COLLECTION
BLEND SYSTEM
OIL SUPPLY
SEPARATE
104
106
INFUSION SUGAR SUPPLY
86
FINES COLLECTION
INFUSED PRODUCT COLLECTION
JUICE PRODUCT COLLECTION
65
88
108
110

FIG. 3

FRUIT EXTRACTION AND INFUSION

FRUIT EXTRACTION AND INFUSION

Field of the Invention

This invention relates to the extraction and infusion of fruits, especially cranberries, for producing various food products.

BACKGROUND OF THE INVENTION

Countercurrent extractors are used in the fruit processing industry for extraction of juices from solid fruit matter. The extractor includes a screw conveyor which urges fruit solids in a first direction, while extraction fluid flows in the opposite direction, extracting juice from the solids by osmosis. Other juice extraction methods used in the processing of cranberries include processes which utilize presses in conjunction with pressing aids (e.g., rice hulls) to produce a high quality single strength juice. Higher yield processes often utilize enzymatic treatment at elevated temperature to break down pectin in raw fruit prior to extraction and may result in a juice of substantially lower quality.

SUMMARY OF THE INVENTION

In aspects of the invention, fruits, especially firm berry fruits such as cranberries, are extracted by an improved countercurrent extraction apparatus resulting in improved and surprising yields of high quality juice, without the need for pressing aids, enzymatic treatments, non excessive heating of extraction liquid or extracted juice mixtures or the fruit itself. Further, because enzymes and high temperatures need not be used, the fruit maintains substantial physical integrity in a decharacterized form post extraction. The decharacterized fruit, a product of the juice extraction process, may be used as a carrier for various flavorings by infusing the decharacterized fruit with a flavored liquid infusion syrup. Particularly, infusion may be achieved with a countercurrent apparatus similar to that used for extraction with the decharacterized fruit being loaded as a solid and the infusion syrup, carrying the flavoring, introduced in a countercurrent fashion. The resulting infused food product, still maintaining substantial physical integrity of the original raw fruit, provides unique flavors by virtue of the various infusion fluids possible, such as fruit juices from fruits other than the fruit decharacterized. The infused fruit product may also maintain the characteristic flavor of the fruit itself to a desired degree.

In various aspects, a sequential, two-step process, extraction followed by infusion is taught herein, that provides particular advantages, especially over processes which simultaneously extract and infuse by soaking fruit in a liquid infusion syrup. In the latter processes, control over the level of natural or inherent soluble fruit component (the composition of materials that contribute to characteristic fruit flavor, including soluble solids such as combinations of sugars and other components, present in the fruit at natural relative levels) in the infused fruit product can be achieved by adjusting the ratio of infusion syrup to fruit, in order to extract the requisite amount of inherent soluble fruit component into the infusion medium, discharging a fraction of the medium as a relatively low value spent syrup byproduct and recycling the remaining fraction to infuse and extract more fruit. Recycling the spent syrup in its entirety causes the level of inherent soluble fruit component in the infusion syrup feed to asymptotically approach that of the fruit feed over time as the syrup is cycled through successive batches or a continuous flow of fruit and renders control over the formulation of the infused fruit product at any target level of inherent soluble fruit component below that characteristic of the fruit virtually impossible.

In the two-step process, on the other hand, the level of inherent soluble fruit component in the infused product can be controlled by the degree of extraction achieved in the extraction step and the degree of infusion of formulated infusion syrup achieved in the infusion step. Preferably, most of the inherent soluble fruit component is extracted from raw fruit to produce a large volume of high quality juice of high commercial value, with a predetermined amount of inherent soluble fruit component retained in the decharacterized fruit so that it maintains partially the natural fruit flavor. In the infusion step, the infusion syrup is formulated with inherent soluble fruit component (e.g. by using juice or juice concentrate) and non-inherent components (e.g. sugars, acids and/or other flavorings and components not present in the natural fruit or not present at the same relative levels as in the natural fruit) in such a manner as to control the formulation of the infused fruit product with respect to its inherent soluble fruit component without the need to bleed off spent syrup as a byproduct of the process. Preferably, there is no net extraction of the inherent component into the infusion media in the infusion step, i.e., the infusion syrup is formulated such that the level of inherent fruit component is equal to or greater than that in the decharacterized fruit. In preferred embodiments, the infusion is carried out with a countercurrent apparatus, and the spent syrup is Concentrated to remove excess water and recycled in its entirety.

For example, raw fruit is extracted such that post extraction the decharacterized fruit contains a small amount, e.g. 1% by weight, of inherent soluble fruit component and a large amount of the extraction fluid, typically pure water. The infusion syrup is formulated such that the level of inherent soluble fruit component in the infusion syrup is approximately 1% by weight; equal in concentration to the level in the decharacterized fruit. During infusion, no net infusion or extraction of inherent soluble fruit component occurs. The spent syrup exiting the infuser is a blend of inherent and non-inherent soluble components diluted by water extracted from the fruit. This spent syrup, comprising a higher relative proportion of inherent fruit component when compared to the target infusion syrup formulation, can be recovered and recycled in its entirety by concentrating to remove the excess water and adding the requisite amount of non-inherent components to adjust the formulation in line with the desired infusion syrup feed. If the syrup is formulated to comprise a higher concentration of inherent fruit component than in the extracted fruit, there will be a net infusion of the inherent fruit components into the decharacterized fruit. In this case, the spent syrup can be recycled in its entirety by concentrating to remove the excess water and adding the requisite amount of inherent fruit components (e.g., by adding juice or juice concentrate) to adjust the formulation in line with the desired infusion syrup feed. In either case, the syrup can be concentrated without the aid of enzymes to a level appropriate for subsequent formulation in infusion syrup. Thus, there is no need to

bleed off spent syrup as a low value byproduct, since it can be concentrated and then recycled in its entirety without adversely effecting the formulation of the infused fruit product.

By contrast, in processes which simultaneously extract and infuse by soaking fruit in an infusion syrup (as previously discussed), to produce an infused product having a low inherent fruit component level only a fraction of the spent syrup generated can be recycled. In effect, the level of inherent soluble fruit component in the infused product can only be controlled by removing the requisite amount of inherent soluble fruit component in spent syrup as a low value byproduct.

The invention is therefore of a particular economic advantage since the inherent fruit component which needs to be removed from the fruit (in order to control the formulation of the infused product) is removed up front, prior to infusion, as a high value high quality fruit juice. Process costs are also significantly reduced by the more efficient handling of spent infusion syrup. Further, this feature is of particular importance for infusion of high-acid fruits, such as cranberries, which require low controlled amounts of inherent soluble fruit component to enhance sweetness and make the infused fruit product more palatable but still reminiscent of cranberry flavor.

"Decharacterized fruit" as used herein refers to whole fruit or fruit pieces that have been subjected to extraction such that at least 50% of soluble solids have been removed. "Firm fruit" as used herein are those which resist structural collapse under substantial compression and typically are extracted in prior processes with the aid of pectinase enzymes and/or high temperature to increase yield. Examples include, apples, cranberries, cherries and grapes. On the other hand, "soft fruits" are easily collapsed. Examples include raspberries, blackberry and the meat of various fruits especially tropical fruits, e.g., kiwi, guava, mango and passion. (Fruits of this type are also typically extracted in prior processes with the aid of enzymes and/or high temperatures to increase yield.) It will be understood that processes of the invention may achieve advantages such as improved yield, quality and lower cost with many fruits. All percentages herein are by weight unless otherwise indicated or apparent.

In a first aspect, the invention features a countercurrent apparatus for use with fruit solids that has an elongate housing in the form of a trough or tube with an inlet at or adjacent one end and an outlet at or adjacent the other end. A screw conveyor with a substantially helical flight is disposed within the housing. The flight is rotatable about its longitudinal axis for moving fruit solids which have been introduced into the housing through the inlet from the one end to the other end of the housing. Means are provided for introducing liquid into the other end of the housing in a manner such that introduced liquid will flow along the housing to the one end thereof and counter current to the fruit solids. A drive means causes the screw conveyor to rotate for providing a net forward motion of the fruit solids from the one end to the other end. Means are also provided for withdrawing liquid from the housing at a point at or adjacent the one end thereof. The apparatus is characterized by a screw conveyor that includes a series of narrow longitudinal members parallel to the conveyor axis positioned between adjacent flights.

Various embodiments include the following features. The longitudinal members are radially positioned from the periphery, preferably, about 10% to 70% the distance from the periphery to the axis of the flights. There are 1 to 12 longitudinal members per square foot of flight area. The longitudinal members are positioned in a circumferential pattern about the axis of the flights. Two sets of members are provided at different radii from the axis. One set of longitudinal members are provided at a radius of about 25% the distance from the periphery of said flight to the axis and a second set of longitudinal members at a radius about 50% the distance from the periphery to the axis of said flight. The longitudinal members may be relatively rigid wires or rods with a diameter in the range of 0.032 to 0.500 inches. The direction of rotation of the screw conveyor is intermittently reversed.

In another aspect, the invention features extracting juice from fruit by providing raw fruit in a dimensionally stable form, penetrating the skin of the fruit to expose the inside of the fruit, unprotected by skin, and treating the fruit with a liquid in a countercurrent apparatus by advancing the fruit along a path while flowing the liquid countercurrently to the advancing fruit and uniformly, continuously tumbling the fruit while treating the fruit with the liquid and maintaining a process temperature of about 75° F. or less during extraction, and collecting the extract from the fruit.

In another aspect, the invention features treating fruit by providing raw fruit, penetrating the fruit to expose the inside of the fruit, unprotected by the skin, countercurrently extracting juice from the fruit with an extraction liquid to provide extracted fruit, collecting the extract from the fruit, collecting the extracted fruit, subjecting the extracted fruit to countercurrent infusion with an infusion liquid to provide an infused fruit, and collecting the infused fruit.

In another aspect, the invention features a method for processing fruit by providing raw fruit, penetrating the fruit to expose the inside of the fruit, unprotected by the skin, extracting the fruit with an extraction liquid to provide decharacterized fruit having a desired level of inherent soluble fruit component, collecting the extract from the fruit, collecting the decharacterized fruit, formulating an infusion liquid having inherent soluble fruit component at a level equal to or greater than the decharacterized fruit, infusing the decharacterized fruit with the infusion liquid without net extraction of the inherent soluble fruit component from the decharacterized fruit, collecting the spent infusion liquid after infusion, concentrating the spent liquid, recycling the concentrated spent liquid in its entirety for subsequent infusion, and collecting the infused fruit.

The features of these aspects may be combined. In addition, various embodiments may include one or more of the following features. The raw fruit is frozen prior to extraction. The residence time of fruit for extraction is greater than about 90 minutes, such as about 120 to 150 minutes. The extraction liquid is substantially free of pectinase enzymes, e.g. the extraction liquid is water. Uniformly tumbling is achieved between the flights of a screw conveyer by passing narrow longitudinal members positioned parallel to the axis of the screw through the fruit. A temperature of about 100° to 130° F. is maintained during the infusion step. The residence time of the fruit is about 120 to 300 minutes during the infusion. The fruit is cranberry. The method includes concentrating the spent liquid by removing excess water, reformulating the infusion liquid by adding a desired amount of inherent and/or non-inherent

soluble components to concentrated, spent liquid, and recycling the reformulated liquid in its entirety for subsequent infusion. The infusion liquid is selected from fruit juice, fruit juice concentrate, corn syrup, sugar-water solutions, artificial sweeteners or any combination of the above, and may be fortified with flavorings, vitamins, and/or minerals. The infusion liquid has 60 to 80 brix. The decharacterized fruit has been extracted of about 94 to 98% of soluble solids. The decharacterized fruit is infused to about 40 to 55 brix. The infused fruit is dried to remove excess water to a water activity of 0.5 to 0.55.

In another aspect, the invention features food products made by method aspects of the invention. The food product may be a decharacterized cranberry having removed therefrom at least about 90% of its inherent soluble solids and including therein a flavor syrup.

Embodiments may include the following. The decharacterized fruit piece has about 94 to 98% of the inherent soluble solids removed. The syrup is a fruit flavor different from the fruit piece. The food product has brix of about 40 or greater. The fruit is a cranberry. The decharacterized fruit is free from enzyme degradation and substantially maintains the structural integrity of raw fruit, being untreated by pectinase enzymes. The decharacterized fruit has been extracted of about 50% or more of its original color (total anthrocyanine content measured by alcohol extraction).

Other aspects, features and advantages follow.

DETAILED DESCRIPTION

We first briefly describe the drawings.

Drawings

FIG. **1** is a side view schematic of a countercurrent extractor;

FIG. **2** is a perspective schematic of a screw conveyor;

FIG. **2***a* is an end-on view of the screw conveyor of FIG. **2**, taken along the lines a—a;

FIG. **3** is a flow diagram of a fruit extraction/infusion process;

FIG. **4** is a perspective illustration of a dried infused fruit product;

EXTRACTOR/INFUSER

Referring to FIG. **1**, a countercurrent apparatus **10** for use, e.g., as an extractor, includes an elongate troughshaped housing **11** with a helical screw conveyor **2** intermittently rotated by a motor means **20**, connected to a shaft **4** on its longitudinal axis. Housing **11** has an inlet hopper **14** for the introduction of material to be extracted, particularly raw cranberries, and an outlet **15** at the other end of the trough housing is provided for removal of extracted fruit pieces. The hopper **14** is disposed above the lower end of the screw which is inclined slightly upwardly at angle Θ. A charging line **17** is provided for charging extraction liquid, typically pure water, into the housing **11** and a discharge line **16** for the discharge of liquid extract, a mixture of extraction liquid and juice. The trough temperature may be controlled (e.g., by heating or cooling with a circulating water jacket (not shown) positioned about the trough) to control the process temperature. Alternatively or in addition the temperature of the fruit or extraction liquid may be preselected prior to introduction to the extractor. The screw conveyor is operated by intermittently reversing the direction of rotation of the screw. The reversal helps the relatively compacted mass of matter being extracted to be opened up enhancing the penetration of extracting liquid. Other details of a suitable countercurrent extractor are described in U.S. Pat. No. 4,363,264, the entire contents of which are hereby incorporated by reference. Commercially available fruit extractor units (e.g., CCE Model 275, Howden Equipment Services Pty, Ltd., Sydney, Australia) may be modified and operated with beneficial results as described further below.

Referring to FIGS. **2** and **2***a*, the screw conveyor **2** includes a series of vertical, helical flights **5**, having wire or rod longitudinal members **8** positioned between adjacent flights and extending longitudinally generally parallel to the conveyor shaft **4** which has an axis A (corresponding to the axis of the flight). As shown particularly in FIG. **2***a*, the wire members **8**, may be tied to slits **7** of the flights **5**. Typically, the wires are positioned at least about 10 percent and preferably no more than about 70 percent the distance from the outer periphery of each flight to the axis A and equidistantly in a circumferential pattern. The wires must be stiff enough to pass through the fruit mass without excessive bending to cause the fruit to uniformly tumble along the length between the flights of the conveyor as the shaft rotates. In particular embodiments, (employing CCE Model 275), a set of wires is positioned at d_s, about 1.5 inch from the periphery for flights of 10.8 inch diameter (wires positioned about 25% of the distance from the periphery to the axis), and three wires are used of a diameter with approximately 0.06 inch. (The diameter of shaft **4** is about 2.9 inches.) An optional second set of wires **8'** (FIG. **2***a* only) may be provided at a distance of about 3 inch from the periphery (about 50% of the distance from the periphery to the axis). In some embodiments, especially with larger flights, multiple circumferential sets of wires may be provided at various radii between the axis and periphery. In some embodiments, the wires might be positioned closer to the axis between flights near the raw fruit inlet **14** than between flights near the extracted fruit outlet **15**. Positioning the wires further from the axis within the specified range has a greater tumbling effect near the decharacterized fruit outlet **15** where the fruit is usually more compacted. Typically, about 1 to 12 wires per square foot of flight area are provided. Preferably, the longitudinal members are positioned equi-distantly radially and circumferentially. Preferably, longitudinal members are provided between adjacent flights for the entire length of the conveyor.

As further described in the Examples below, it has been found that, by employing longitudinally extending members, such as wires **8**, improved efficiency in extraction of juices from fruit may be achieved, even in the case of firm berry fruits such as cranberries. In addition, it has been found that a countercurrent apparatus, as described, can be used for the infusion of fruit decharacterized by extraction to provide new food products. In this case, extracted, decharacterized fruit is placed in the inlet hopper **14** and an infusion liquid carrying a desired flavor is introduced through charging line **17**. The infused fruit product exits outlet spout **15**. The use of members **8** also improves efficiency of the infusion.

Preferred and typical parameters for operation of a countercurrent apparatus with the improved conveyor for extraction of cranberries are given in Table I below and parameters for infusion of decharacterized cranberries with an improved conveyor are given in Table II

below. "Extract level" and "infusion liquid level" refers to the depth of these liquids compared to the screw flight nearest the discharge line **16**. The "process temperature" is the temperature of the liquid in the trough. (The temperature of liquid in the trough is typically measured about one half the length of the trough from the fruit inlet and is generally the highest temperature along the trough in cases where unheated fruit and liquid are introduced at either end.) The screw rotation is the speed at which the screw rotates in any direction (e.g. during intermittent rotation). The water/fruit and infusion syrup/fruit feed rate ratio are the weight ratios of the rates at which these components are fed to the trough. For operation with a preferred countercurrent apparatus, CCE model 275 modified as discussed, the berry weight in the trough and berry feed rate are also given. (It will be understood that desired feed rates for liquid and fruit for an infusion or extraction apparatus of any size may be calculated from the tables below, knowing the trough capacity of the particular unit used and the range of feed ratios specified below.)

TABLE I

	Range	Typically
Process Variable		
inclined ange Θ (degrees)	2 to 6	4
process temperature (deg. F.)	45 to 75	65
fruit residence time (minutes)	30 to 180	135
screw rotation (rpm)	1 to 4	2
water/fruit feed rate ratio (weight ratio)	1:1 to 4:1	2.5:1
extract level (% of flight diameter at discharge)	50 to 70%	60%
For CCE Model 275		
Berry weight in Trough (lbs)	70–80	75
Berry feed rate (lbs/hr)	23–160	33

For infusion of cranberries, the countercurrent apparatus is preferably operated with the parameters in Table II below.

TABLE II

	Range	Typically
Process Variable		
inclined angle θ (degrees)	2 to 6	4
process temperature (°F.)	100 to 130	110
fruit residence time (minutes)	120 to 300	240
screw rotation (rpm)	1 to 4	2
infusion liquid/fruit feed rate ratio (weight ratio)	2:1 to 6:1	3:1
infusion liquid level (% of flight diameter at discharge)	50 to 70%	60%
For CCE Model 275		
dicharacterized fruit weight in Trough (lbs.)	65–75	70
decharacterized fruit feed rate (lbs/hr.)	13–38	17.5

Process

Referring now to FIG. **3**, a flow diagram is shown of a preferred process employing extraction followed by infusion and preferably using countercurrent apparatus as described above with respect to FIGS. **1–2***a*. (It will be understood that other extractors and infusers may be used in the process.) The process will be described for use with cranberries, although it may be adapted for use with other fruit, especially firm fruit.

Whole raw fruit which has been bulk frozen is provided to a cleaning stage **40** to remove debris such as twigs, leaves, soil, etc. and then conveyed to a sorting stage **42** which sorts fruit of a selected size, within a selected deviation, and removes rotten or damaged fruit. The freezing of the fruit prior to further processing is believed to be an important aspect of the invention, in that, upon rethawing, the fruit is structurally more susceptible to juice extraction. Again, the deleterious effect on juice quality associated with high temperature treatment (or the use of enzymes) is avoided. The frozen fruit is in the raw state, without having been boiled or otherwise cooked prior to processing. The frozen fruit (e.g., initially at about 25° F.) thaws naturally upon exposure to the flume water (e.g., about 55° F.) and the extraction trough (e.g., about 65° F.) without any substantial heating. As discussed above, generally, exposure to heat is avoided especially prior to and during extraction, so that the fruit is not exposed to average process temperatures above about 75° F.

Control over the average size and standard deviation of the raw fruit is also believed an important attribute of the present process whereas a uniformly sized infused product ultimately results. In the case of cranberries, preferably the sorted berries are 16 to 20 millimeters (mm) in diameter with a standard deviation of about 1 mm. The size-selected fruit is later passed to a dicer stage **44** (Model RG-6, A. B. Hallde Maskiner, Kista, Sweden) which slices the berries to expose the inner pulp of the fruit unprotected by the skin. The whole cranberries are preferably cut in half to provide slices between 8 to 10 millimeters in width, although other skin penetrating treatments such as scarifying may also be used.

The sliced fruit is transported by means of a flume to a separation stage **46**, including a vibrating screen separation apparatus (Model LS24S444, Sweco, Inc., Florence, Ky.) which separates the sliced fruit from the flume water, recycling water back to the flume, and removes seeds at a seed collection stage **48**. The sliced fruit is then provided to the solid input **51** of an extractor stage **50** which employs a countercurrent extractor which may be as previously described with respect to FIGS. **1–2***a* and operated within the limits of Table I. The liquid input **53** to the extractor is the extraction liquid, typically pure water without added enzyme, from a supply **52**. The liquid output **54** of the extractor stage is an enzyme-free, high-quality extract mixture of extraction liquid and fruit juice which exhibits desirable qualities such as low tannin content. The extractor, preferably operating at low temperatures, but at high efficiency, avoids the detrimental effects on juice quality normally associated with higher temperature extraction, such as reduced shelf-life characteristics, burnt notes in the juice flavor and higher tannin levels. The raw juice extract from the extractor stage liquid output **54** is further treated, first in a separation stage **56**, using a vibrating screen separator (Model LS24S444, Sweco, Inc., Florence, Ky.) which collects in collection stage **66** any remaining seeds and solids. The juice extract is further treated in a depectinization stage **58** in which pectinase enzyme is provided from a supply **60** and mixed with the juice extract. The enzyme, in small amounts (between about 0.01 and 0.1 percent) clears the juice extract of pectin in preparation for a filtration stage **62**. Whereas the juice has already been extracted from the fruit, the enzyme plays no substantial role in the overall extraction process and thereby only small amounts of the enzyme, known to be an expensive process ingredient, need be used. Filtration at stage **62** is

achieved by means of a microfilter of 0.1–0.5 micron pore size. The filtered juice extract is further treated at a reverse osmosis stage **64**, (Model BRO, Paterson Candy, Inc.) where the juice extract is passed through a membrane system under pressure to concentrate the final juice product, which is collected at stage **65** as is the excess water at stage **68**. Typically, the final juice product is of about 18 brix. The cranberry juices produced by the process typically have a tannin content less than about 1900 mg/L, e.g. about 1700 mg/L (measured at 7.5 brix).

Decharacterized cranberry pieces, exiting the solid output **71** of extraction stage **50**, are typically characterized by the removal of about 96 percent of the soluble solids and about 80 to 96 percent of the color. At higher temperatures, for example, at 85° to 105° F. virtually all of the color can be removed from the decharacterized fruit, if desired. Extraction time can be extended to achieve the same end. Decharacterized fruit lacking all of its original color may be advantageous for producing infused fruit products that are to take on a color other than that of the original fruit. Similarly, for producing an infused product that is characteristic, in appearance, of a cranberry, an amount of the color suggestive of the cranberry is maintained in the decharacterized fruit.

The decharacterized fruit is supplied to an infusion stage **72** including a countercurrent apparatus similar to that used at the extraction stage **50** and as discussed with respect to FIGS. **1–2***a*, operated in the ranges given in Table II. Liquid input at the infusion stage **72** is the desired infusion liquid such as sugar-water (e.g., fructose) solution, high fructose corn syrup, white grape juice, strawberry juice, raspberry juice, blueberry juice, apple juice and their concentrates. These infusion liquids may include flavoring, e.g., spices such as cinnamon and may be fortified with vitamins, e.g. ascorbic acid, and/or minerals, e.g. iron. The infusion liquid typically has a sugar level of about 72 brix and is provided from a continuous process loop which mixes the spent infusion liquid from the liquid output **74** from infusion stage **72** with syrup from a supply **76** which is then treated in a vibrating screen separator **78** (Model LS24S444, Sweco, Inc., Florence, Ky.) to remove and collect seeds and fines at a collection state **80**. The spent infusion mixture is then concentrated at concentration stage **82** including a water collection stage **84** and finally, the liquid is treated at a blend stage **86** which may include input from an infusion sugar supply **88**, before being recycled to the liquid input **90** of infuser **72** as the infusion liquid. As discussed above, the infusion liquid can be formulated to include a desired amount of natural or inherent soluble fruit component, equal to or greater than the amount present in the decharacterized fruit so that no net extraction of inherent soluble fruit component into the infusion media occurs during infusion. The infused fruit product has the desired level of inherent soluble fruit component and the spent infusion liquid is concentrated and recycled in its entirety.

The infused fruit product exiting the infusion stage at the solid output **92** is passed to a screening stage **94** at which the infused fruit product is separated from excess infusion liquid coating the solid product, which is collected at collection stage **96**. The excess syrup may be provided to syrup supply **76** for recycling to the infuser **72**. The infused fruit product is then provided to a dryer stage **98** which passes forced air through the infused fruit product to remove water at stage **100**. Drying temperature is typically in the range of about 180° to 200° F. for about 120 minutes using a conventional forced air fruit dryer. The dried, infused fruit product is next passed to an oiler stage **102** which includes an oil supply **104** from which vegetable oil or the like is applied to the fruit product to enhance flowability. A screen separator (Model LS24S444, Sweco, Inc., Florence, Ky.) **106** with a stage **108** is used for collection of any fines and waste. The final dried infused product, maintaining substantial physical integrity of the original fruit, is collected in a collection stage **110** from which it may be bulk packaged. The dried product preferably has a sugar level of about 88 brix.

Referring to FIG. **4**, a dried infused cranberry fruit product according to the invention is illustrated. The fruit product maintains substantial structural integrity of the original cranberry including the skin **114** and typically a portion of the original color of the cranberry. The flavor of the fruit product however is that of the infusion syrup which may be of many varieties including a controlled amount of flavor of the original fruit. A coating may be applied which also contributes to flavor and/or nutrient value.

The invention will be further described by way of the following examples.

EXAMPLE 1

The process described in FIG. **3** can be operated using raw frozen cranberries as the fruit input. In the extraction stage (referring as well to Table I) the process temperature is about 65° F., with a residence time of about 135 min., a screw rotation of 2 rpm, a water/-berry weight ratio of 2.5:1 and extraction liquid (water) level of 60%. The extraction stage produces a decharacterized fruit with 0.3% inherent soluble fruit component. The infusion stage (referring as well to Table II) can employ an aqueous blend of sucrose (68.0%) and cranberry fruit components (4.0%) as the infusion syrup and a countercurrent apparatus identical to that in the extraction stage, operated at a temperature of about 110° F., residence time of about 180 min., screw rotation of about 2 rpm, infusion liquid to berry weight ratio of about 4:1. The spent infusion syrup can then be collected to be concentrated and reformulated as discussed herein. Target inputs and outputs from the various stages are summarized in Table III, below. All calculations are normalized to 8 lbs. of fruit soluble solids per 100 lbs. of cranberries.

TABLE III

PROCESS STAGE (FIG. 3)	MATERIAL	AMOUNT	CONCENTRATION (WATER PHASE)
40/42	FROZEN SORTED CRANBERRIES	100.0 LBS	8 brix
44	FLUME RECYCLE (WATER)	900.0 LBS	
48	CRANBERRY SEEDS	0.3 LBS	
51	SLICED CRANBERRIES	99.7 LBS	
53	WATER	250.0 LBS	
54/56	JUICE EXTRACT/WATER	257.7 LBS	3 brix

TABLE III-continued

PROCESS STAGE (FIG. 3)	MATERIAL	AMOUNT	CONCENTRATION (WATER PHASE)
60	ENZYME	0.1 LBS	
65	CRANBERRY JUICE/WATER	43.0 LBS	18 brix
66	TRASH (SEEDS/FINES)	0.1 LBS	
68	WATER	214.7 LBS	
71	EXTRACTED DECHARACTERIZED SLICES	92.0 LBS	0.3 brix
74	SPENT SYRUP	256.0 LBS	55 brix
80	TRASH (SEEDS/FINES)	0.1 LBS	
84	WATER	37.9 LBS	
88	INFUSION SUGAR	61.0 LBS	
90	INFUSION SYRUP	284.0 LBS	72 brix
92/94	INFUSED FRUIT PIECES	120.0 LBS	55 brix
96	EXCESS SYRUP	5.0 LBS	55 brix
100	WATER	41.6 LBS	
104	OIL	0.1 LBS	
108	FINES	17.5 LBS	
110	DRIED INFUSED FRUIT SLICES	56.0 LBS	88 brix

The cranberry juice product provided by the process at stage **65** typically has a tannin content less than about 1900 mg/L (at 7.5 brix), and has no noticeable off-flavors associated with heat abuse. As the table indicates, the process is highly efficient for the production of cranberry juice with 43 lbs. of juice (at 18 brix) being produced from 100 pounds of cranberries. This corresponds to 96% recovery on a weight basis (FSP, fruit soluble solid pounds, i.e., percent fruit soluble solid recovery based on weight of fruit soluble solid in raw fruit compared to that recovered in the extract). In addition, the process provided a new fruit product in the way of infused cranberry slices having the sweetened flavor of the infusion syrup.

EXAMPLE 2

The efficiency of juice recovery employing an improved extractor was illustrated by a series of comparative experiments (experiments 1 to 6) in which process parameters for extraction were varied, as summarized in Table IV below.

TABLE IV

Process parameter	Experiment 1	2	3	4	5	6
Unit Size	pilot	pilot	pilot	pilot	pilot	commercial
Enzymes in Extraction Liquid	Yes	No	No	No	No	No
Improved Extractor (FIGS. 1-2a)	No	No	Yes	Yes	Yes	Yes
Residence Time (min)	90	90	90	135	160	135
Extraction Temperature (°F.)	85–115	85–115	85–115	85–115	69–75	65
Efficiency % FSP recovery	75	67	84	96	96	96
Relative Tannin Content mg/L	2146	1950	2381	2292	1734	1273

In Experiment 1, a pilot sized extractor unit (nominal capacity=30 kilograms per hour) was used to extract juice from cranberries, employing in the extraction liquid enzymes effective in pectin breakdown (about 0.07–0.15 lbs./100 lbs. feed). The extractor was of a commercially available type (CCE Model 275, Howden Equipment Services Pty, Sydney, Australia). The efficiency of extraction was approximately 75% of available FSP with a relatively high (2146 mg/L, measured at 7.5° brix) tannin content.

In Experiment 2, similar process conditions were employed, with the exception that no enzyme was introduced to the extraction liquid. The efficiency of extraction dropped to about 67% of available FSP.

In Experiment 3, the extractor unit was modified as described with respect to FIGS. **1–2***a;* a series of longitudinally extending wires were provided between adjacent flights of the extractor screw. Surprisingly, by employing the improved countercurrent unit, extraction efficiency increased to about 84% of available FSP recovery without the use of enzymes, representing a significant improvement over operation of the conventional extractor (even with the use of enzymes).

In Experiment 4, the improved countercurrent apparatus was operated with extended residence time (135 minutes) compared to Experiment 3 (90 minutes). Under these conditions, extraction efficiency increased to about 96% of available FSP recovery.

In Experiment 5, the extraction temperature was reduced to about 69°–75° F., compared to about 85° to 115° F. used in Experiments 1 to 4 (with the residence time marginally increased). Surprisingly, the extraction efficiency remained at about 96% of available FSP recovery and the resulting juice product was of improved quality over that of experiments 1 to 4, in that the juice exhibited significantly lower tannin levels.

In Experiment 6, the extraction efficiency of a much larger commercial scale extraction unit (CCE model 500, nominal capacity=500 kilograms per hour) was investigated and the results compared to that obtained with the smaller pilot scale unit used in the previous experiments. The unit employed an extractor screw modified to include longitudinally extending wires between adjacent flights and was operated at an extraction temperature of 65° F., with residence times of about 135 minutes. The extraction efficiency was similar to that obtained in the smaller unit.

Other embodiments are within the following claims.

We claim:

1. A method for efficiently extracting from fruit a juice that has not been exposed to high temperatures, comprising:

providing raw fruit in a dimensionally stable form,

penetrating the skin of said fruit to expose the inside of said fruit, unprotected by skin,

treating said fruit with an extraction liquid in a countercurrent apparatus by advancing said fruit along a path while flowing said liquid countercurrently to said advancing fruit and uniformly, continuously tumbling said fruit while treating said fruit with said liquid,

maintaining a process temperature of about 75° F. or less during said extracting and,

collecting said liquid extracted from said fruit to provide said juice that has not been exposed to high temperatures.

2. The method of claim 1 wherein the residence time of said fruit during said extracting in said countercurrent apparatus is greater than about 90 minutes.

3. The method of claim 2 wherein the residence time is about 120 to 150 minutes.

4. The method of claim 3 further comprising freezing said raw fruit prior to said providing step.

5. The method of claim 4 wherein said extraction liquid is water substantially free of pectinase enzymes.

6. The method of claim 1 or 5 wherein said uniformly tumbling includes tumbling between flights of a screw conveyer by passing narrow longitudinal members positioned parallel to the axis of said screw conveyer through said fruit.

7. The method of claim 6 wherein said fruit is cranberry.

8. A method for processing fruit, comprising:

providing raw fruit,

penetrating said fruit to expose the inside of said fruit, unprotected by the skin,

countercurrently extracting said fruit with an extraction liquid while maintaining conditions, including a low temperature, that provide extracted fruit with substantially the structural integrity of the raw fruit, and a fruit extract that has not been exposed to high temperatures,

collecting the extract from said fruit,

collecting the extracted fruit, and

countercurrently infusing said extracted fruit with an infusion liquid while maintaining conditions that provide an infused fruit with substantially the structural integrity of the raw fruit, and

collecting said infused fruit.

9. The method of claim 8 comprising freezing said raw fruit prior to said providing step.

10. The method of claim 8 further comprising collecting spent infusion liquid after said countercurrent infusion, concentrating said spent liquid and recycling said concentrated liquid in its entirety for subsequent infusion.

11. The method of claim 10 comprising:

extracting said fruit to provide a decharacterized fruit having a selected level of inherent soluble fruit component, and

formulating said infusion liquid to have a level of inherent soluble fruit component substantially equal to or greater than said level in said decharacterized fruit

12. The method of claim 8 wherein said decharacterized fruit has been extracted of about 94 to 98% of soluble solids.

13. The method of claim 8 wherein said infusion liquid includes a liquid selected from fruit juice or fruit juice concentrate, corn syrup, sugar-water solutions, and artificial sweeteners or combination thereof.

14. The method of claim 13 wherein the infusion liquid is fortified with a material selected from the group consisting of vitamins, flavorings, minerals, and combinations thereof.

15. The method of claim 8 wherein said infusion fruit to about 60 to 80 brix.

16. The method of claim 8 comprising infusing said fruit to about 40 to 55 brix.

17. The method of claim 16 further comprising drying said infused fruit to remove water.

18. The method of claim 17 comprising drying said infused fruit to about 40 brix or greater.

19. The method of claim 17 comprising drying said infused fruit to a water activity of about 0.5 to 0.55.

20. The method of claim 8 wherein the extraction liquid is water substantially free of pectinase enzymes.

21. The method of claim 20 comprising extracting said fruit by advancing said fruit and flowing an extracting liquid countercurrently to said advancing fruit, while continuously uniformly tumbling said fruit between the flights of a screw conveyor by passing narrow longitudinal members parallel to the axis of said conveyer through said fruit.

22. The method of claim 21 further comprising infusing said decharacterized fruit by advancing said fruit and flowing an infusing liquid countercurrently to said advancing fruit, while continuously uniformly tumbling said fruit between the flights of a screw conveyor by passing narrow longitudinal members parallel to the axis of said conveyer through said fruit.

23. The method of claim 22 further comprising

maintaining the temperature at about 75° F. or less during said extracting step.

24. The method of claim 23 comprising maintaining a residence time of said fruit of greater than about 90 minutes during said extraction.

25. The method of claim 24 wherein the residence time of said fruit is about 120 to 150 minutes.

26. The method of claim 25 comprising maintaining a process temperature of about 100° to 130° F. during said infusing.

27. The method of claim 26 comprising maintaining a residence time of said fruit of about 120 to 300 minutes during said infusing.

28. The method of any one of claims 8, 20 or 23 wherein said fruit is cranberry.

29. A method for processing fruit, comprising:

providing raw fruit,

penetrating said fruit to expose the inside of said fruit, unprotected by the skin,

extracting said fruit with an extraction liquid to provide decharacterized fruit having a desired level of inherent soluble fruit component,

collecting the extract from said fruit,

collecting the decharacterized fruit,

formulating an infusion liquid having inherent soluble fruit component at a level equal to or greater than said decharacterized fruit,

infusing said decharacterized fruit with said infusion liquid without net extraction of said inherent soluble fruit component from said decharacterized fruit,

collecting a spent infusion liquid after said infusing,

concentrating said spent liquid,

recycling said concentrated spent infusion liquid for subsequent infusion, and

collecting said infused fruit.

30. The method of claim **29** including reformulating said infusion liquid by the addition of non-inherent soluble component to said concentrated spent syrup.

31. The method of claim **30** including reformulating said infusion liquid by the addition of inherent soluble fruit component to said concentrated spent liquid.

32. The method of claim **31** wherein said infusing includes countercurrently infusing.

33. The method of claim **32** wherein said extraction liquid is water-free of pectinase enzymes.

34. The method of claim **29** or **33** comprising freezing said raw fruit prior to said providing step.

35. The method of claim **34** comprising maintaining a process temperature of about 75° F. or less during said extracting step.

36. The method of any one of claims **1, 5, 7, 23, 29** or **35** wherein said fruit is cranberry and said extract has a tannin content of less than about 1900 mg/L measured at 7.5 brix.

37. A raw cranberry fruit food product, comprising:

a decharacterized cranberry fruit piece having removed therefrom at least about 90% of its inherent soluble solids and including therein a flavor liquid, said product having a brix of about 40 or greater.

38. The food product of claim **37** wherein about 94 to 98% of the soluble solids have been removed.

39. The food product of claim **37** wherein the syrup is a fruit flavor different from the fruit piece.

40. The food product of claim **37** wherein said decharacterized fruit is free from added enzyme degradation, substantially maintaining the structural integrity of the raw fruit, being untreated by pectinase enzymes.

41. The food products of claim **37** wherein said decharacterized fruit has been extracted of about 50% or more of its original color.

* * * * *

UNITED STATES PATENT AND TRADEMARK OFFICE
CERTIFICATE OF CORRECTION

PATENT NO. : 5,320,861

DATED : Jun. 14, 1994

INVENTOR(S) : Harold L. Mantius et al.

It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

Column 1, line 31, delete "non", insert therefor --nor--.

Column 2, line 34, delete "C" in the word concentrated, insert therefor lower case --c--.

Column 14, claim 15, delete "fruit to about", insert therefor --liquid has--.

Signed and Sealed this

Tenth Day of September, 1996

Attest:

BRUCE LEHMAN

Attesting Officer

Commissioner of Patents and Trademarks

[redacted]

EXHIBIT 7

Robert J. Brink, Esq.
Executive Director

SOCIAL LAW
LIBRARY

NOTICE
WARNING CONCERNING
COPYRIGHT REGISTRATIONS

The copyright law of the United States (Title 17, United States Code) governs the making of photocopies or other reproductions of copyrighted material.

Under certain conditions specified in the law, libraries and archives are authorized to furnish a photocopy or other reproduction. One of these specified conditions is that the photocopy or reproduction is not to be "used for any purpose other than private study, scholarship, or research." If a user makes a request for, or later uses, a photocopy or reproduction for purposes in excess of "fair use," that user may be liable for copyright infringement.

This institution reserves the right to refuse to accept a copying order if, in its judgment, fulfillment of the order would involve violation of copyright law.

§ 52.1821 Determining the grade of a lot.

The grade of a lot of canned white potatoes covered by these standards is determined by the procedures found in the "Regulations Governing Inspection and Certification of Processed Fruits and Vegetables, Processed Products Thereof, and Certain Other Processed Food Products" (7 CFR 52.1 through 52.83).

Subpart—United States Standards for Grades of Processed Raisins[1]

SOURCE: 41 FR 34751, Aug. 17, 1976, unless otherwise noted. Redesignated at 42 FR 32514, June 27, 1977 and at 46 FR 63203, Dec. 31, 1981.

§ 52.1841 Product description.

Processed Raisins are dried grapes of the Vinifera varieties, such as Thompson Seedless (Sultanina), Muscat of Alexandria, Muscatel Gordo Blanco, Sultana, Black Corinth or White Corinth. The processed raisins are prepared from clean, sound, dried grapes; are properly stemmed and capstemmed except for cluster or uncapstemmed raisins; are properly seeded in seeded styles; are sorted or cleaned, or both; and except for cluster or uncapstemmed raisins, are washed in water to assure a wholesome product.

§ 52.1842 Product description of Layer or (Cluster) raisins with seeds.

Raisins with Seeds that are referred to as "Layer or Cluster raisins" means that the raisins have not been detached from the main bunch.

§ 52.1843 Summary of types (varieties) of processed raisins.

(a) Type I—Seedless Raisins.
(1) Natural.
(2) Dipped, Vine-dried, or similarly processed raisins.
(b) Type II—Golden Seedless Raisins.
(c) Type III—Raisins with Seeds.
(1) Natural.
(i) Seeded (seeds removed).
(ii) Unseeded-capstemmed (loose).
(iii) Unseeded-uncapstemmed (loose).
(iv) Layer (or Cluster).
(2) Dipped, Vine-dried, or other similarly processed raisins.
(i) Seeded (seeds removed).
(ii) Unseeded-capstemmed (loose).
(iii) Unseeded-uncapstemmed (loose).
(d) Type IV—Sultana Raisins.
(e) Type V—Zante Currant Raisins.
(i) Unseeded.
(ii) Seeded.
(f) Type VI—Mixed Types or Varieties of Raisins. A mixture of two or more different types (varieties) of raisins including sub-types outlined in this section but other than: (1) Mixtures containing Layer or Cluster Raisins with seeds; (2) Mixtures containing Unseeded-capstemmed and Unseeded-uncapstemmed Raisins with Seeds; and (3) mixture of Seeded and Unseeded Raisins with Seeds.

§ 52.1844 Definition of terms.

(a) "Capstems" means small woody stems exceeding ⅛-inch in length which attach the raisins to the branches of the bunch.
(b) A "piece of stem" means a portion of the branch or main stem.
(c) "Seeds" refers to whole, fully developed seeds which have not been removed during the processing of seeded raisins with seeds.
(d) "Damaged raisins" means raisins affected by sunburn, scars, insect injury, mechanical injury, or other similar means which seriously affect the appearance, edibility, keeping quality, or shipping quality of the raisins. In seeded Raisins with Seeds, mechanical injury resulting from normal seeding operations is not considered damage.
(e) "Sugared" means either external or internal sugar crystals are present and the accumulation of such crystallized fruit sugars in the flesh or on the surface of the raisins is readily apparent.
(f) "Grit, sand, or silt" means any particle or earthy material.
(g) "Moisture" means the percentage by weight of the processed raisins, exclusive of branch and heavy stem ma-

[1] Compliance with the provisions of these standards shall not excuse failure to comply with the provisions of the Federal Food, Drug, and Cosmetic Act, or with applicable State laws and Regulations.

terial, that is moisture when determined by the "Dried Fruit Moisture Tester Method" or in accordance with other methods that give equivalent results.

(h) "Slightly discolored" means a raisin affected by a brown to dark brown discolored area around the capstem end of the raisin that is less than the area of a circle ⅛-inch in diameter.

(i) "Discolored" means a raisin affected by a brown to dark brown discolored area around the capstem end of the raisin that equals or exceeds the area of a circle ⅛-inch in diameter; *Provided,* That the overall appearance, keeping quality, and edibility of the product are not seriously affected.

(j) "Well-matured" means raisins that are full-fleshed, may have fine wrinkles and are rounded in appearance.

(k) "Reasonably well-matured" means raisins that are reasonably full-fleshed and may have shallow wrinkles with thick edged ridges.

(l) "Fairly well-matured" means raisins that are thin-fleshed and angular in appearance.

(m) "Substandard development" means raisins that are practically lacking in flesh.

(n) "Undeveloped" refers to extremely light berries that are lacking in sugary tissue indicating incomplete development; are reddish in color; are completely shriveled; have fine wrinkles on smaller units and moderately deep wrinkles on slightly larger units; and are commonly referred to as "worthless."

Type I—Seedless Raisins

§ 52.1845 Sizes of seedless raisins.

The size designations and measurement requirements for the respective sizes are:

(a) "Select" size raisins means that no more than 60 percent, by weight, of all the raisins will pass through round perforations $^{22}/_{64}$-inch in diameter, but not more than 10 percent, by weight, of all the raisins may pass through round perforations $^{20}/_{64}$-inch in diameter.

(b) "Small" or "midget" size raisins means that 95 percent, by weight, of all the raisins will pass through round perforations $^{24}/_{64}$-inch in diameter, and not less than 70 percent, by weight, of all raisins will pass through round perforations $^{22}/_{64}$-inch in diameter.

(c) "Mixed" size raisins means a mixture which does not meet either the requirements for "select" size or for "small" or "midget" size.

§ 52.1846 Grades of seedless raisins.

(a) "U.S. Grade A" is the quality of seedless raisins that have similar varietal characteristics; that have a good typical color; that have a good characteristic flavor; that show development characteristics of raisins prepared from well-matured grapes with not less than 80 percent, by weight, of raisins that are well-matured or reasonably well-matured; that contain not more than 18 percent, by weight, of moisture for all varieties of seedless raisins except the Monukka variety, which may contain not more than 19 percent, by weight, of moisture; and that meet the additional requirements outlined in Table I of this subpart.

(b) "U.S. Grade B" is the quality of seedless raisins that have similar varietal characteristics; that have a reasonably good typical color; that have a good characteristic flavor; that show development characteristics of raisins prepared from reasonably well-matured grapes with not less than 70 percent, by weight, of raisins that are well-matured or reasonably well-matured; that contain not more than 18 percent, by weight, of moisture for all varieties of seedless raisins except the Monukka variety, which may contain not more than 19 percent, by weight, of moisture; and that meet the additional requirements outlined in Table I of this subpart.

(c) "U.S. Grade C" is the quality of seedless raisins that have similar varietal characteristics; that have a fairly good typical color; that have a fairly good flavor; that show development characteristics of raisins prepared from fairly well-matured grapes with not less than 55 percent, by weight, of raisins that are well-matured or reasonably well-matured; that contain not more than 18 percent, by weight, of moisture for all varieties of seedless raisins except the Monukka variety,

which may contain not more than 19 percent, by weight, of moisture; and that meet the additional requirements outlined in Table I of this subpart.

(d) "Substandard" is the quality of seedless raisins that fail to meet the requirements of U.S. grade C.

[43 FR 51754, Nov. 7, 1978. Redesignated at 46 FR 63203, Dec. 31, 1981]

TABLE I—ALLOWANCES FOR DEFECTS IN TYPE I, SEEDLESS RAISINS AND TYPE II, GOLDEN SEEDLESS RAISINS

Defects	U S Grade A	U S Grade B	U S Grade C
	Maximum count (per 96 ounces)		
Pieces of stem	1	2	4
	Maximum count (per 16 ounces)		
Capstems	15	25	35
	Maximum (percent by weight)		
Sugared	5	10	15
Discolored, damaged or moldy raisins	4	6	9
Provided these limits are not exceeded			
Damaged	2	3	5
Moldy	2	3	4
	Total		
Substandard development and undeveloped			
Selected size	1	1½	2
Mixed size	1	2	3
Small (Midget) size	2	3	5
	Appearance or edibility of product		
Slightly discolored or damaged by fermentation or any other defect not described above	May not be affected	May not be more than slightly affected	May not be materially affected
Grit, sand, or silt	None of any consequence may be present that affects the appearance or edibility of the product		Not more than a trace may be present that affects the appearance or edibility of the product

TYPE II—GOLDEN SEEDLESS RAISINS

§ 52.1847 Colors of golden seedless raisins.

The color of Golden Seedless Raisins is not a factor of quality for the purpose of these grades. The color requirements applicable to the respective color designations are as follows:

(a) "Well colored" means that the raisins are practically uniform in color and may range from yellow or golden to light amber color with a predominating yellow or golden color and that not more than ½ of 1 percent, by weight, of all the raisins may be definitely dark berries.

(b) "Reasonably well colored" means that the raisins are reasonably uniform in color and may range from yellow or golden or greenish yellow to light amber wherein the predominating color may be greenish yellow or light amber and that not more than 3

EXHIBIT 8

Webster's Third New International Dictionary

OF THE ENGLISH LANGUAGE

UNABRIDGED

A Merriam-Webster
REG. U.S. PAT. OFF.

Utilizing all the experience and resources of more than one hundred years of Merriam-Webster® dictionaries

EDITOR IN CHIEF
PHILIP BABCOCK GOVE, Ph.D.
AND
THE MERRIAM-WEBSTER
EDITORIAL STAFF

MERRIAM-WEBSTER INC., *Publishers*
SPRINGFIELD, MASSACHUSETTS, U.S.A.

A GENUINE MERRIAM-WEBSTER

The name *Webster* alone is no guarantee of excellence. It is used by a number of publishers and may serve mainly to mislead an unwary buyer.

Merriam-Webster™ is the name you should look for when you consider the purchase of dictionaries or other fine reference books. It carries the reputation of a company that has been publishing since 1831 and is your assurance of quality and authority.

Library of Congress Cataloging in Publication Data
Main entry under title:

Webster's third new international dictionary of the English language, unabridged: a Merriam-Webster/editor in chief, Philip Babcock Gove and the Merriam-Webster editorial staff.
p. cm.
ISBN 0-87779-201-1 (blue sturdite).—ISBN 0-87779-202-X (carrying case), — ISBN 0-87779-206-2 (imperial buckram).
1. English language—Dictionaries. I. Gove, Philip Babcock, 1902–1972. II. Merriam-Webster, Inc.
PE1625.W36 1993
423–dc20 93-10630
CIP

MADE IN THE UNITED STATES OF AMERICA
4647AG/H9594

neyanus) little regarded for food or sport **3** : SWAGMAN **4** : TRAVELING SALESMAN **5** : a workman who tends a drum

drumming *pres part of* DRUM

drum-mock \'drəmäk\ *var of* DRAMMOCK

drum-mond light \'drəmənd-\ *n, usu cap D* [after Thomas *Drummond* †1840 Brit. engineer] : LIMELIGHT 1a, 1b

drum-mond's phlox \-mən(d)z-\ *n, usu cap D* [after James *Drummond* †1863 Brit. botanical collector] : a phlox (*Phlox drummondii*) native to Texas and widely cultivated in many varieties as an ornamental

drum printing *n* : a process for dyeing woolen yarns for tapestry and velvet carpets by winding the yarns on a large drum and applying the dye in horizontal bands of varying width

drums *pl of* DRUM, *pres 3d sing of* DRUM

drum sander *n* : a cylindrical wheel with abrasive (as sandpaper) mounted on its outer curved surface and used for sanding flat surfaces of decorative stones

drum saw *n* : BARREL SAW

drum scale *n* : CYLINDER SCALE

drum sieve *n* : a sieve in a box like a drum used for fine powders

drumskin \'ˌ-ˌ\ *n* : TYMPANIC MEMBRANE

drumslade *n -s* [D *trommenslager, trommelslager*, fr. *tromme, trommel* drum + *slager* beater, fr. *slagen* to beat (fr. MD *slaen*) + *-er;* akin to OE *slēan* to beat, slay — more at DRUM, SLAY] *obs* : DRUMMER

drum slide *n* : a drawing of the backs of the fingers across the strings of a banjo to produce an arpeggio chord

drumstick \'ˌ-ˌ\ *n* **1** : a stick for beating a drum — see DRUM illustration **2** : something resembling a drumstick in form; *specif* : the segment of a fowl's leg between the thigh and tarsus **3** : a capsule of the horseradish tree

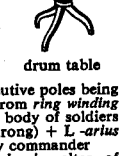
drumstick tree *n* [so called fr. the shape of the pods] **1** : an East Indian tree (*Cassia fistula*) having pods whose pulp is used medicinally — called also *pudding-pipe tree, purging cassia;* see CASSIA FISTULA **2** : HORSERADISH TREE 1

drum-stretch \'ˌ-ˌ\ *vt, bookbinding* **1** : to fasten (as fabric) to another material by drawing taut and securing at the edges **2** : to flatten and dry out (pasted or wet materials) by fastening clamps or weights to the edges

drum stuffing *n* : a rapid method of stuffing a leather by rotating it in a heated drum until warm, adding liquid grease to the drum, and then rotating again for a short time

drum switch *n* : an electric switch in which the connecting parts are held by spring pressure against contact surfaces in a revolving cylinder or sector

drum table *n* : a round-topped table supported on a central pedestal with a deep apron often containing drawers



drum table

drum up *vt* : to arouse by persistent effort : SOLICIT ⟨tried to *drum up* sentiment against the commission —A.H.Raskin⟩ ⟨*drum up* trade⟩ ⟨*drum up* support⟩; *also* : ORIGINATE, INVENT ⟨when the campaign was over, he told himself, he was going to *drum up* some way of making liquor —Norman Mailer⟩

drum washer *n* : a drum for washing paper pulp

drum winding *n* : an armature winding in which the coils are arranged upon the outer surface of a cylinder with those under consecutive poles being united by end connections — distinguished from *ring winding*

drungar *n -s* [ML *drungarius*, fr. LL *drungus* body of soldiers (of Gmc origin; akin to OE *thrang* crowd, throng) + L *-arius* -ary, -ar — more at THRONG] *obs* : a military commander

¹drunk \'drəŋk\ *adj* -ER/-EST [ME *drunke, dronke*, alter. of *drunken*] **1** : being in a condition caused by alcoholic drink in which control of the faculties is impaired and inhibitions are broken and in later stages of which one tends toward or reaches insensibility ⟨he came home ~⟩ ⟨~ folks were never quiet —Truman Capote⟩ **2** : dominated as if under the influence of alcohol by some feeling (as fanatic zeal, imperious pride, or passionate love) so that calm, judicious, realistic reflection is impossible ⟨if ~ with sight of power, we loose wild tongues —Rudyard Kipling⟩ ⟨he was ~, not with wine, but with joy —Maurice Samuel⟩ **3** *obs* : DRUNKEN 2 ⟨arrows ~ with blood —Deut 32 : 42 (RSV)⟩ **4** : relating to, caused by, or attended by intoxication ⟨a ~ and fitful sleep⟩ ⟨convicted of ~ driving —*Time*⟩

syn DRUNKEN, INTOXICATED, INEBRIATED, TIPSY, TIGHT: DRUNK and DRUNKEN are plainspoken rather blunt words which do not imply either censure or apology and do not suggest exact degrees of intoxication. The former is generally postposed or predicative, the latter often preposed ("you think I am *drunk?*" "I think you have been drinking" — Charles Dickens⟩ ⟨he had seen front yards littered with empty bottles, and three *drunken* boys sprawling on the grass after a dance at a club —Ellen Glasgow⟩ DRUNKEN may suggest habitual excessive use of alcohol ⟨a *drunken* sot⟩ INTOXICATED does not indicate an exact degree of drunkenness, but, since its suggestions are learned and polite, it may indicate relatively slighter effects ⟨and *intoxicated* as he was . . . he knew enough to charge the steward . . . with the present safety of the ship —Herman Melville⟩ INEBRIATED and the less common INEBRIATE suggest more noisy, hilarious, or roistering indulgence ⟨volunteering to sing a song (which he did in that maudlin high key peculiar to gentlemen in an *inebriated* state) —W.M.Thackeray⟩ All of these preceding words may be used to describe the effects of any dominating feelings, emotions, or thoughts ⟨England was *drunk* with her glory and with the hope of plunder —J.R.Green⟩ ⟨he was no longer conscious of his emotions. He had become demented, *drunk* with the fury of his hatred —Liam O'Flaherty⟩ ⟨*drunken* with blood and gold —P.B.Shelley⟩ ⟨I dream that at Naples, at Rome, I can be *intoxicated* with beauty --R.W.Emerson⟩ ⟨he drank in the natural influences of the scene, and was *intoxicated* as by an exhilarating wine —Nathaniel Hawthorne⟩ ⟨intellects *inebriate* with summer —Emily Dickinson⟩ TIPSY, mild and venial in suggestion, implies difficulty with muscular coordination and unsteadiness ⟨drinking steadily, until just manageably *tipsy*, he contrived to continue so —Herman Melville⟩ TIGHT implies rather pronounced intoxication almost to the point of loss of muscular control, discretion, or judgment ⟨He was *tight*, and, as was characteristic of him, he soon dropped any professional discretion that he might have been supposed to exercise —Edmund Wilson⟩

²drunk \'ˌ *n -s* **1** : a period of excessive drinking : SPREE ⟨after a week's ~ and a week to sober himself —F.M.Ford⟩; *also* : a condition of drunkenness ⟨old men sleeping off ~*s* in the gutters —*Wisconsin Idea Theatre Quarterly*⟩ **2** : a drunken person : DRUNKARD ⟨the great cost of jailing and hospitalizing ~*s*⟩

drunk-ard \-kə(r)d\ *n -s* [*drunk* + *-ard*] **1** : one who habitually becomes drunk : one suffering from or subject to acute or chronic alcoholism **2** **drunkards** *pl, NewEng* : CHECKERBERRY

drunkard's chair *n* : a wide upholstered armchair popular in 18th century England

¹drunk-en \-kən *sometimes* -kᵊn\ *adj* [ME, fr. OE *druncen*, fr. past part. of *drincan* to drink — more at DRINK] **1** : DRUNK 1 ⟨when he was ~, he was vulgar and silly —Katherine A. Porter⟩ ⟨reeled like a ~ giant —H.G.Wells⟩ **2** *obs* : saturated with liquid or moisture : DRENCHED ⟨let the earth be ~ with our blood —Shak.⟩ **3 a** : given to habitual excessive use of alcoholic drinks ⟨we can not afford to have poor people anyhow, whether they be lazy or busy, ~ or sober —G.B.Shaw⟩ **b** : of, relating to, attended by, or characterized by intoxication ⟨they come from . . . broken homes, ~ homes —P.B. Gilliam⟩ ⟨a ~ cry⟩ ⟨not in a ~ triumph but with awe —S.T. Coleridge⟩ **c** : resulting from or as if from alcoholic intoxication ⟨~ stupor⟩ ⟨the diver is subject to wild, ~ delusions —Rachel L. Carson⟩ **4** : unsteady or lurching as if from alcoholic intoxication ⟨insects which have walked on films of DDT soon begin to stagger in a ~ manner —*Atlantic Monthly*⟩ **5** : DRUNK 2 ⟨still ~ with hope and despair —Eve Langley⟩ **6** *of a screw thread* : having inequalities of pitch : WOBBLY

syn see DRUNK

²drunken *vi* -ED/-ING/-S *obs* : to become drunk

drunk-en-ly *adv* : in a drunken manner

drunk-en-ness \-kən(n)əs\ *n* -ES [ME *drunkennesse*, fr. OE *druncenness*, fr. *druncen* + *-nesse* -ness] **1** : the condition of being drunk with or as if with alcohol : INTOXICATION **2** : ALCOHOLISM **3** : mental or emotional extravagance suggestive of the disorders caused by alcohol ⟨the ~ of factious animosity —T.B.Macaulay⟩

drunken saw *n* : a circular saw fixed askew on its spindle so as to cut a groove whose width is determined by the angle of tilt of the saw — called also *wobble saw*

drunker *comparative of* DRUNK

drunk-ery \'drəŋkərē\ *n* -ES *archaic* : a place for drinking liquor : SALOON

drunkest *superlative of* DRUNK

drunk-om-e-ter \ˌdrəŋ'kämə|d-ə(r), 'drəŋkəˌmē|\ *n* [*¹drunk* + *-o-* + *-meter*] : a device for measuring the alcohol content of the blood through a chemical analysis of the breath

dru-pa \'drüpə\ *also* **drok-pa** \'dräkpə\ *or* **druk-pa** \-rük-\ *n, pl* **drupa** *or* **drupas** *usu cap* **1** : a mountain-dwelling nomadic people of Tibet **2** : a member of the Drupa people

dru-pa-ceous \(')drü'pāshəs\ *adj* [*drupe* + *-aceous*] : of or relating to a drupe : bearing drupes ⟨~ fruits⟩ ⟨~ trees⟩

drupe \'drüp\ *n -s* [NL *drupa*, fr. L *druppa, druppa* overripe olive, fr. Gk. *dryppa* olive] : a one-seeded indehiscent fruit having a hard bony endocarp, a usu. fleshy mesocarp, and a thin epicarp like a skin (as in the cherry, plum, and peach) or dry and almost leathery (as in the almond) — called also *stone fruit;* see DRUPELET

drupe of peach showing section of skin and flesh and surface of stone

drupe-let \-plət\ *also* **drup-el** \-pəl\ *n -s* [*drupelet* fr. *drupe* + *-let; drupel* fr. NL *drupella*, fr. *drupa* + *-ella*] : a small drupe; *specif* : one of the individual parts of an aggregate fruit (as the raspberry)

dru-pif-er-ous \(')drü'pif(ə)rəs\ *adj* [*drupe* + *-i-* + *-ferous*] : bearing drupes

druse \'drüz *also* -zə *esp in sense 3*\ *n -s see sense 3* [G, fr. OHG *druos* gland, bump] **1 a** : a mineral surface covered with small projecting crystals **b** : a cavity in a rock having its interior surface studded with crystals and sometimes filled with water : GEODE **2** : a globose cluster of crystals occurring in plant cells — compare CRYSTAL **3** *pl* **dru-sen** \-zᵊn\ : one of the small hyaline usu. laminated bodies sometimes appearing behind the retina of the eye

dru-sy \-zē\ *adj, usu* -ER/-EST : covered with minute crystals : containing cavities lined with crystals ⟨a ~ surface⟩ ⟨a ~ vein⟩

druth-ers \'drəthə(r)z\ *n pl but sing in constr* [*druther* (dial. alter. of *would rather*) + *-s*] *dial* : free choice : PREFERENCE ⟨if I had my ~ I'd go fishing⟩

druv *dial past of* DRIVE

druxy \'drəksē\ *adj, usu* -ER/-EST [alter. of earlier *drickste*, fr. obs. *drix* decayed part of timber + *-y*] *of timber* : having decayed spots in the heartwood

druze *or* **druse** \'drüz\ *n -s cap* [Ar *Durūz*, pl., fr. Muḥammed ibn- Ismʿaīlal- *Darazīy* †1019 Muslim religious leader, one of the founders] : a member of a tightly organized independent religious sect dwelling chiefly in the mountains of Syria and Lebanon since the 11th century, whose founder advanced the claim that Hakim the sixth Fatimid caliph was the final incarnation of God, and whose other beliefs including the unity of God, the transmigration of souls, and final perfection are drawn from various religions (as Judaism, Christianity, and Islam) — **druz-ean** *or* **drus-ian** \-üzēən, -üzhən\ *adj, cap*

¹dry \'drī\ *adj* **dri-er** *also* **dry-er** \-ī(ə)r, -īə\ **dri-est** *also* **dry-est** \-īəst\ [ME *drie, dry*, fr. OE *drȳge*; akin to OHG *truckan, truchan* dry, MLG *drœge, drȳge*, MD *drȳge* and perh. to ON *draugr* dry wood] **1** : free or relatively free from water or liquid : not wet or moist: as **a** *obs* : naturally having no moisture — used in ancient and medieval sciences to describe one of the qualities of the four elements; opposed to *moist* **b** *of a sign of the zodiac* : having a dry complexion **2** : characterized by loss of water or of life-giving moisture: as **a** : lacking or comparatively free from precipitation and humidity ⟨the path is dusty on a ~ day⟩ ⟨a ~ summer⟩ **b** : lacking freshness : WITHERED **c** : ANHYDROUS **3 a** : not being in or under water : beneficially not having undue moisture or water ⟨~ land⟩ ⟨~ clothes⟩ **b** : employing no liquid or as little as possible ⟨the ~ method of assaying gold⟩ ⟨portland cement may be manufactured by ~ process or wet process⟩ — compare WET 8 **c** : built or constructed without the use of any process that requires water: (1) : using no mortar ⟨~ masonry⟩ ⟨a ~ stone wall⟩ (2) : using prefabricated plaster board, composition board, or wood paneling rather than a construction involving plaster or mortar bonding ⟨a ~ wall⟩ ⟨~ wall construction⟩ **d** *of breadstuff* : served or eaten without butter or milk — now used chiefly of toast without butter **e** *of a foodstuff* : having the water removed by evaporation : DEHYDRATED; *often* : reduced to powder or flakes **f** *of natural gas* : containing little or no recoverable gasoline or other liquid hydrocarbon **g** *of a friction clutch* : intended to function without lubrication **4 a** (1) : harmfully devoid of water or lubricant ⟨the garden is ~ from lack of rain⟩ ⟨the machine automatically stops when it runs ~⟩ (2) : THIRSTY ⟨he felt ~ after his walk⟩ **b** : marked by the absence of or abstention from alcoholic beverages ⟨it was a ~ party but the food was good⟩ ⟨a man who had been ~ for a dozen years —*N.Y. Times Bk. Rev.*⟩ **c** (1) : containing no uncombined water — used esp. of a paint or pigment (2) : wholly solidified : no longer liquid or sticky — used esp. of a coating (as paint) or ink applied to a surface or of the surface so treated; opposed to *wet* **d** : exclusive of accessories and operating fluids (as lubricant and coolant) — used of the weight of an engine **5** : characterized by exhaustion of a supply of water or other liquid: as **a** *of a container or receptacle* : depleted of liquid contents : EMPTY ⟨a ~ well⟩ ⟨the fountain pen ran ~ in the middle of a sentence⟩ **b** : devoid of running water ⟨a ~ ravine⟩ **6** *of an animal or its udder* : not giving milk : not lactating ⟨a ~ cow⟩ **7 a** (1) : not shedding tears ⟨hardly a ~ eye at the funeral⟩ (2) : not accompanied by tears ⟨a ~ sob⟩ **b** : continent of urine ⟨some children learn to stay ~ much earlier than others⟩ **c** (1) : marked by the absence or scantiness of secretions, effusions, or other forms of moisture ⟨a ~ pleurisy⟩ (2) *of a cough* : not accompanied by the raising of mucus or phlegm **8 a** *obs* : free from bloodshed : not causing or accompanied by effusion of blood ⟨~ war⟩ ⟨~ death⟩ **b** : designed or executed in practice or planning for the future and lacking some essential (as live ammunition) of the situation being simulated : intended for practice only ⟨~ rehearsal⟩ ⟨~ firing⟩ **9 a** : solid as opposed to liquid ⟨~ groceries⟩ ⟨~ provisions⟩ ⟨~ cargo⟩ **b** : SLACK 6 **10 a** : not manifesting or communicating warmth, responsiveness, sympathy, enthusiasm, or tender feeling whether through natural indifference or studied unconcern : IMPASSIVE, UNEMOTIONAL, MATTER-OF-FACT ⟨under that peculiar sort of ~, blunt manner, I know you have the warmest heart —Jane Austen⟩ ⟨she sat there looking ~ and indifferent —Lionel Trilling⟩ **b** *fine art* : exhibiting a sharp frigid preciseness of execution : lacking delicate contour in form or easy transition in coloring **11 a** : not yielding what is expected or desired : not giving satisfaction : BARREN, STERILE, UNPRODUCTIVE ⟨a poet who is going through a ~ period which he finds frustrating —Rosemary Benét⟩ **b** *obs, of a person* : STINGY **c** *dial* : RESERVED, ALOOF **12** : marked by a matter-of-fact manner of expression that seems unconscious or unintentional but is actually ironic, caustic, keen, shrewd, terse — used esp. of humor or the person expressing it ⟨his ~ humor which made him say the most amusing things and keep his face so absolutely solemn —Eleanor Roosevelt⟩ **13** : having no personal inclination, bias, or emotional concern : having clear impartial perception or judgment ⟨ought . . . to have used the ~ light of reason in discussing matters of high morality, politics and religion —*Times Lit. Supp.*⟩ ⟨a certain ~ spirit of detachment and analysis —Aldous Huxley⟩ **14** : dull because lacking in inherent interest and adornment : lacking elements that would lend attractiveness and appeal : UNINTERESTING, WEARISOME, INSIPID ⟨in the *dryest* passages of her historical summaries these delightful descriptions come running to the rescue —Robert Payne⟩ ⟨his ~ schoolmaster temperament, the hurdy-gurdy monotony of him —William James⟩ **15 a** : having nothing superfluous : lacking embellishment : consisting of essentials only : UNADORNED, PLAIN, BARE ⟨~ simplicity⟩ ⟨~ fact⟩ ⟨~ formality⟩ **b** *archaic* : paid in actual coin — used of money or fees **c** *of a dog* : having the skin close fitting esp. about the neck and mouth **16 a** (1) *of beverages* : lacking sweetness (2) *of wines and other fermented beverages* : having all or most sugar fermented to alcohol : SUGARLESS ⟨~ champagne⟩ ⟨~ sauterne⟩ — see SEC **b** *of mixed drinks* : containing only ingredients low or lacking in sugar content ⟨a ~ martini⟩ **c** : marked by a harsh, rasping, or jarring tone : lacking smooth or liquid sound qualities ⟨a ~ rasping voice⟩ ⟨a chipping sparrow gives a ~, unmusical trill —W.P.Smith⟩ ⟨the ~ whisper of winter leaves —Edith Sitwell⟩ ⟨this recording of the piano solo is ~ and harsh⟩ **17** : relating to or favoring the prohibition or drastic regulation and limitation of the manufacture or distribution of alcoholic beverages ⟨~ law⟩ ⟨~ agent⟩ ⟨~ sentiment⟩ ⟨a ~ state⟩

syn ARID: ARID is usu. more extreme than DRY. DRY suggests freedom from moisture or deficiency of moisture, ARID destitution or deprivation of moisture and extreme dryness ⟨not a drop of water could we find, and the *arid* aspect of the valley as a whole showed only too plainly that the rainfall, on this side of the island at least, must be scant indeed —C.B. Nordhoff & J.N.Hall⟩ DRY suggests lack of qualities compelling interest, ARID absence of worthwhile, fruitful, or significant, as well as interesting, qualities ⟨a very *dry* book⟩ ⟨the frank elucidation of such a principle, with an aesthetic near to a moral obligation, might imply only bleak and *arid* results —Holbrook Jackson⟩ Applied to persons, their manner or sayings, DRY implies loss of warmth, responsiveness, enthusiasm, or emotion, ARID an absence of or incapacity for these ⟨this structural defect might have been overcome — and may still be overcome — if the intellectual leadership were less arid —Barbara Ward⟩ **syn** see in addition SOUR

— not dry behind the ears : IMMATURE, NAIVE

²dry \'ˌ\ *vb* **dried; dried; drying; dries** [ME *drien, dryen*, fr. OE *drȳgan*, fr. *drȳge*, adj.] *vt* **1** : to make dry : to rid of moisture or liquid (as by wiping, rubbing, draining, squeezing) — often used with *up, out, off; specif* : to remove or reduce the moisture content of by exposure to heat or air : DESICCATE — compare DEHYDRATE, EVAPORATE **2** : to take up (moisture or liquid) by absorption — usu. used with *up* ⟨the sun will ~ up the dew quickly⟩ **3** : to cause (a female mammal) to stop giving milk — used with *off* or *up* ~ *vi* **1** : to become dry : become free from wetness or moisture — often used with *off, out* ⟨nylon *dries* rapidly⟩ ⟨I *dried* at the electric blower —Saul Bellow⟩ **2 a** *of moisture or a liquid* : to evaporate, become absorbed, or drain away — often used with *up* ⟨the ~*ing* up during the summer of the shallow ponds —W.H.Dowdeswell⟩ **b** : to become hard, tough, and elastic as a result of oxidation and polymerization : SOLIDIFY — used esp. of various oils, paints, and varnishes applied as thin films **3** *of a female mammal* : to stop giving milk — used with *off* or *up*

syn DESICCATE, DEHYDRATE, BAKE, PARCH: DRY is a general term applicable to any process, natural or artificial, whereby moisture is extracted from something ⟨clothes *drying* on the line⟩ ⟨to *dry* up a swamp⟩ ⟨*drying* the dishes with a towel⟩ DESICCATE indicates a complete exhaustion of moisture, with resultant shriveling or withering; in reference to persons it indicates loss of animation, vitality, capacity to interest ⟨*desiccated* fish⟩ ⟨*desiccated* coconut meat⟩ ⟨the spur of an imagination not yet *desiccated* by a too strict adhesion to those so-called 'laws' —Eric Partridge⟩ ⟨achieves her dream of gentility by marrying a stockbroker and settles into a mold of *desiccated* snobbery —C.J.Rolo⟩ DEHYDRATE, like DESICCATE, implies complete elimination of water but usu. lacks additional suggestion ⟨*dehydrated* fruits⟩ It may refer to a condition of the body resulting from loss or deprivation of fluids ⟨he may develop fever from becoming *dehydrated* —Benjamin Spock⟩ BAKE in the meaning here involved may indicate not only drying by heat or fire but also hardening, sometimes with resulting cracking ⟨clay tablets on which all three types were present — that is, tablets on which the wedges had been impressed while they were still soft and then *baked* in —Fletcher Pratt⟩ ⟨the sun-*baked* mud flats⟩ PARCH suggests drying by dry heat or drought; it may imply effects comparable to thirst and suggest that water will restore and refresh ⟨record heat waves which have *parched* mid-America's usually productive plains —*N.Y. Times Mag.*⟩ ⟨we had drunk all our water and so were *parched* and all done in when we finally espied a small, scattered Bedouin camp —*Nat'l Geographic*⟩

³dry \'ˌ\ *n* -ES *see sense 6* [ME *drie, dry*, fr. *drie, dry*, adj.] **1** : the condition of being dry : DRYNESS **2** : something dry: as **a** *chiefly Austral* (1) : the rainless season of the year (2) : a desert area **b** : a place that is dry (as a piece of dry land) **3** [by shortening] : DRYHOUSE **4** : a natural seam constituting a flaw in stone **5** : THIRST; *esp* : a craving for intoxicating liquor **6** *pl* **drys** : PROHIBITIONIST **7** : the action of becoming dry ⟨speed of ~ of printing inks⟩

⁴dry \'ˌ\ *adv* [*¹dry*] : in a dry way ("what a thrilling life you have!" "Yeah," I says, ~ —Bant Singer⟩

dry- *or* **dryo-** *comb form* [NL, fr. Gk, fr. *drys* tree, oak — more at TREE] : tree — in generic names ⟨*Dryopithecus*⟩

dry-ad \'drīˌad, -ī,ad\ *n -s* [L *dryad-, dryas*, fr. Gk, fr. *drys*] : WOOD NYMPH 1

dry-as \'drīəs\ *n* [NL, fr. L] **1** *cap* : a small genus of arctic and alpine tufted plants (family Rosaceae) with simple leaves and white or yellow solitary flowers **2** *pl* **dryas** : any plant of the genus *Dryas*

¹dryasdust \'ˌˌ\ *n -s often cap* [after Dr. Jonas *Dryasdust*, fictitious person to whom Sir Walter Scott †1832 Scottish author dedicated some of his novels] : one that is uninteresting because of concentration upon minutiae : PEDANT ⟨the researches of a *Dryasdust* —C.E.Montague⟩

²dryasdust \'ˌ\ *adj* : marked by characteristics that bring about lack of interest or boredom : UNINSPIRED, PEDANTIC, PROSAIC ⟨~ presentation⟩ ⟨~ scholarship⟩ ⟨a ~ teacher⟩

dry-ash \'ˌˌ\ *vt* : to convert (a sample) to ash in chemical analysis

dry band *or* **dry bunch** *n* : a flock of sheep not including gravid or lactating ewes

dry bark *n* : a phase of shell bark of citrus in which the outstanding symptoms are yellowing and some defoliation, loss of vigor, and death of tissues nearly down to the cambium of trunk and large branches with checking but little or no shelling of the bark

dry battery *n* : a battery of dry cells; *also* : DRY CELL

dry bible *or* **dry bible disease** *n* [*bible* (omasum)] *Austral* : botulism of cattle

dry bone *or* **dry-bone ore** *n* : SMITHSONITE

dry bridge *n, NewEng* : a bridge over a dry way (as a railroad)

drybrush \'ˌˌ\ *n* : a method of ink or watercolor painting in which most of the pigment has been removed from the brush before application

dry budding *n* **1** : PLATE BUDDING **2** : CHIP BUDDING

dry-bulb temperature *n* : temperature indicated by a dry-bulb thermometer that is the actual temperature of the air — contrasted with *wet-bulb temperature;* compare PSYCHROMETER

dry-bulb thermometer *n* : an ordinary thermometer; *specif* : the thermometer with unmoistened bulb in a psychrometer

dry camp *n* : a camp made where there is no source of water

dry cell *n* : a voltaic cell whose contents are made nonspillable by the use of some absorbent (as sawdust or gelatin); *esp* : a cell of the Leclanché type in which a mixture of plaster of paris, flour, and sal ammoniac with water takes the place of the solution

dry-clean \'ˌˌ\ *vt* [back-formation fr. *dry cleaning*] : to subject to dry cleaning

dry cleaner *n* : one whose business is the dry cleaning of textiles

dry cleaning *n* : the cleansing of fabrics with substantially nonaqueous organic solvents (as petroleum naphtha or chlorinated hydrocarbons) to which special detergents or soaps are often added — compare WET CLEANING

dry coal *n* : coal containing little volatile matter

dry color *n* : a pigment in powder form — compare FLUSH COLOR, PULP COLOR

dry course *n* : a starter course in roofing consisting of roofing felt or paper laid over insulation and not bedded in tar or asphalt

dry-cure \'ˌˌ\ *vt* : to cure (as meat) by drying : DRY-SALT — compare PICKLE

dry dash *n* : ROCK DASH